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Hemmi et al.

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(45) **Date of Patent: Mar. 1, 2011**

(54) **CONNECTOR CONNECTION TERMINAL COMPRISING A POINTED PORTION FORMED THROUGH ELECTROFORMING AND CONNECTOR INCORPORATING THE SAME**

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(30) **Foreign Application Priority Data**

Oct. 1, 2008 (JP) 2008-256696

(51) **Int. Cl.**
H01R 13/15 (2006.01)

(52) **U.S. Cl.** **439/260**

(58) **Field of Classification Search** 439/260, 439/494–496, 259
See application file for complete search history.

(56) **References Cited**

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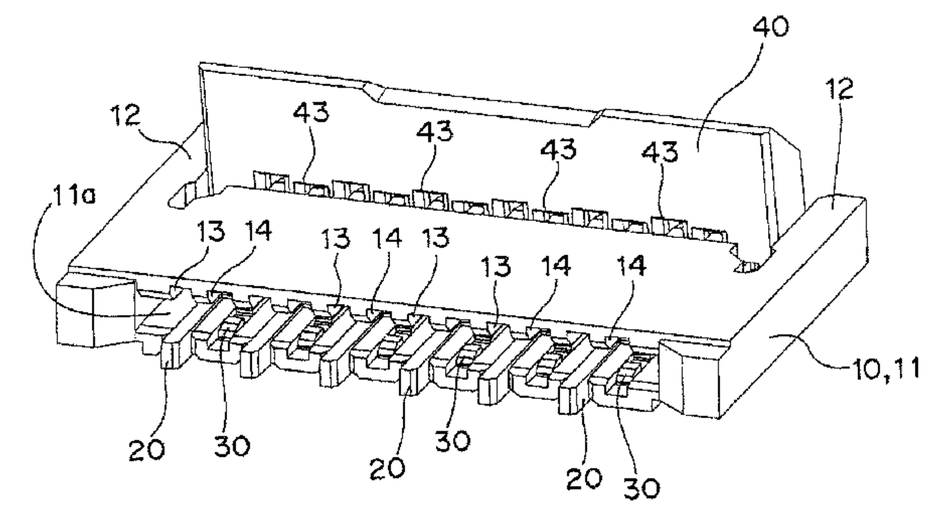
(57) **ABSTRACT**

A connector connection terminal has a fixed piece to be inserted to a base of a connector, a coupling portion extending from the fixed piece, and a movable piece extending in parallel to the fixed piece to both sides from a free end of the coupling portion and being operated by an operation lever rotatably assembled to the base. At least one of the fixed piece and the movable piece includes at least one pointed portion. The connector connection terminal is formed through electroforming.

15 Claims, 13 Drawing Sheets



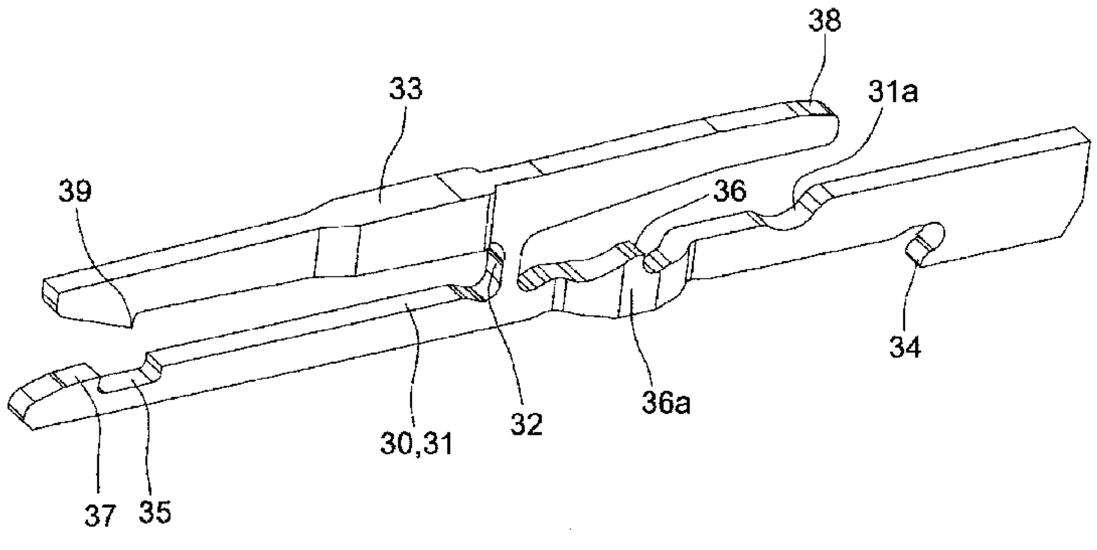


FIG. 1A

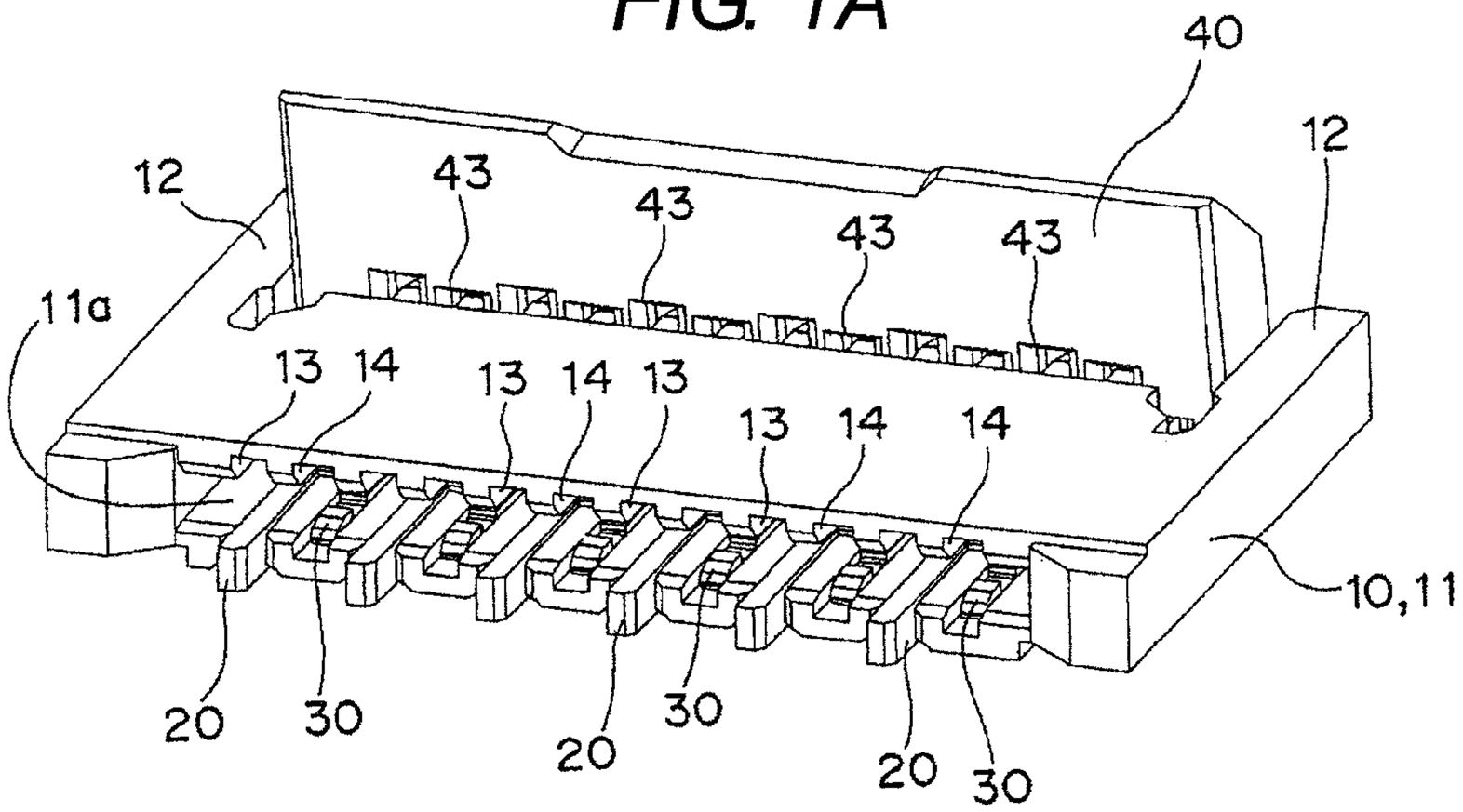


FIG. 1B

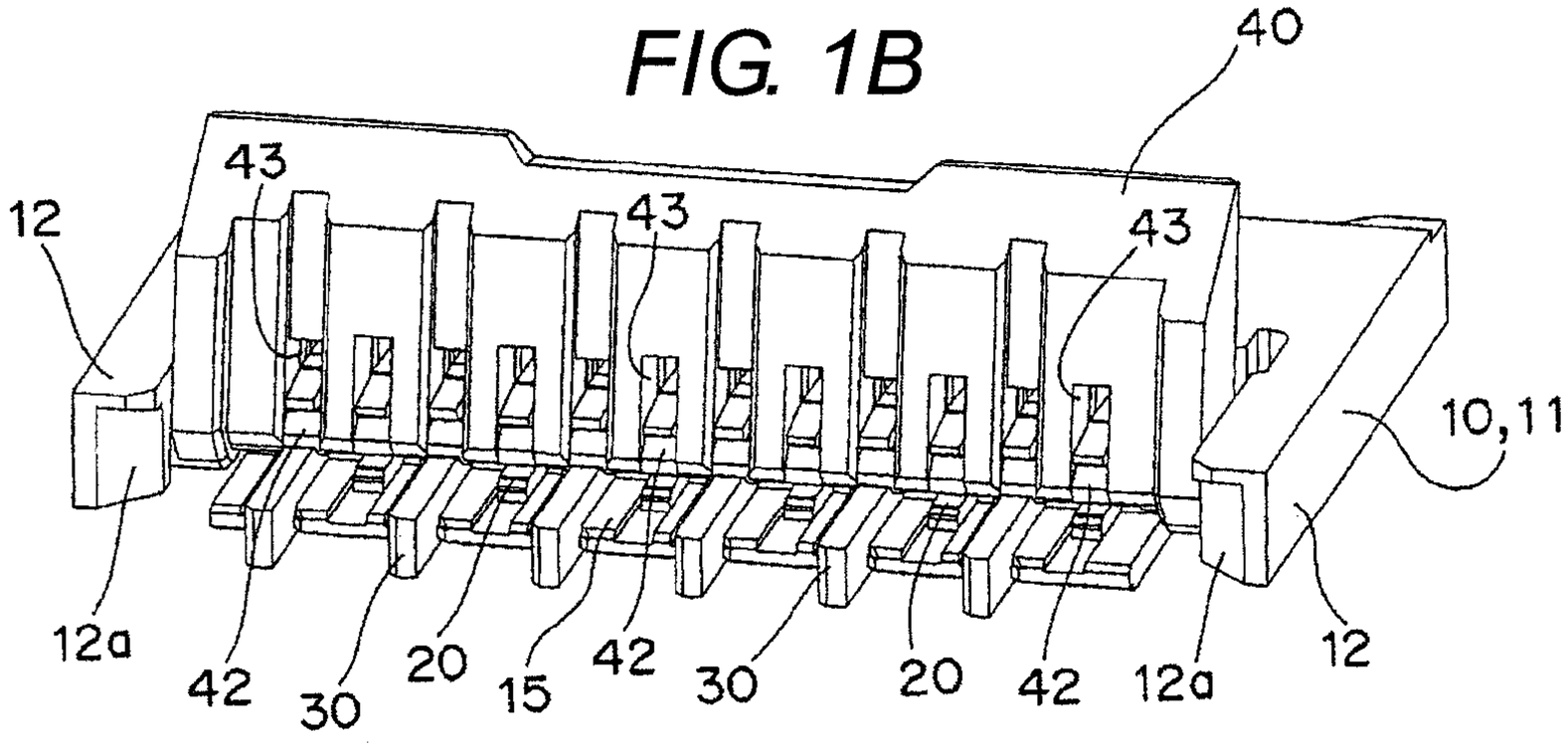


FIG. 1C

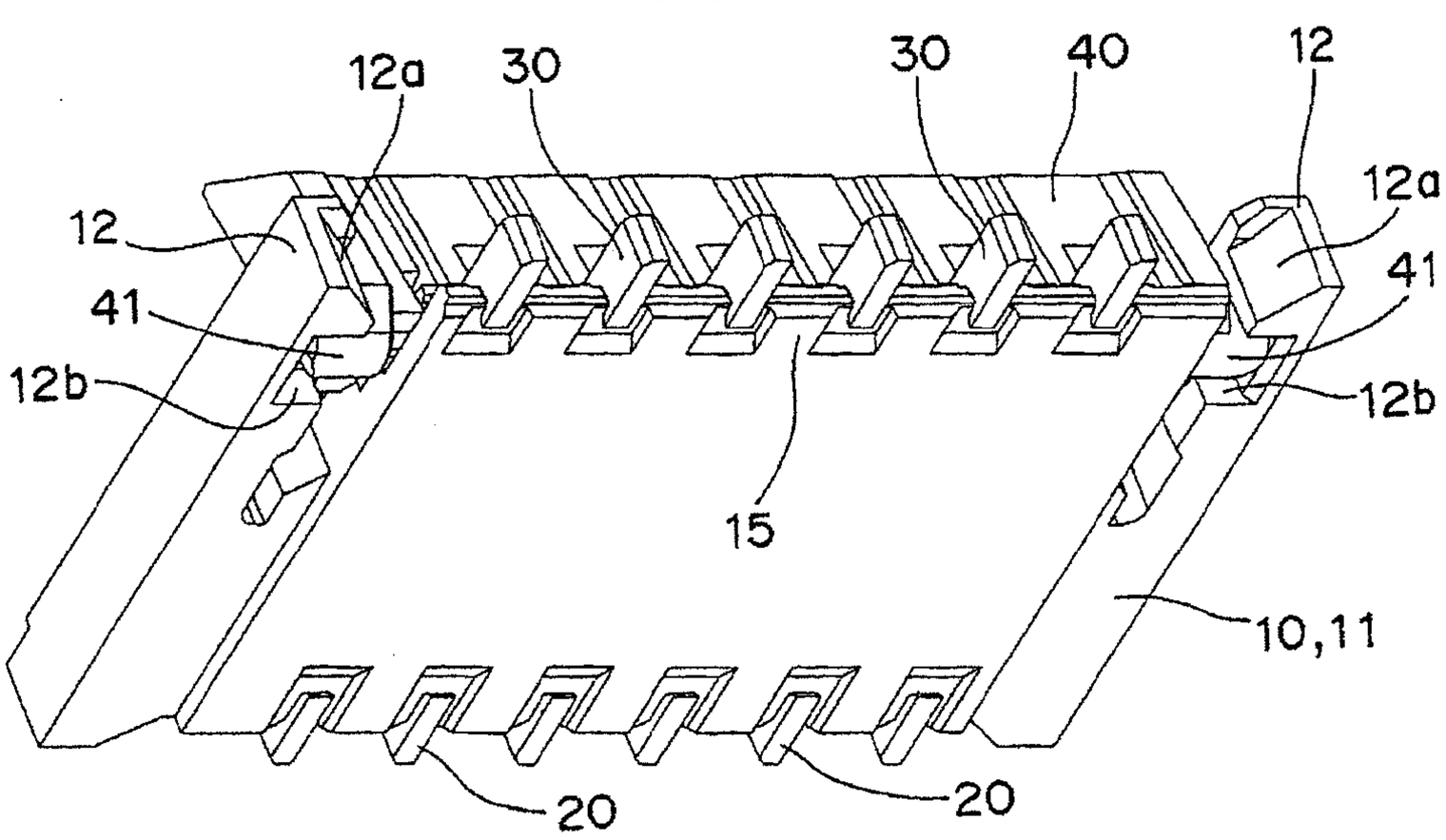


FIG. 2A

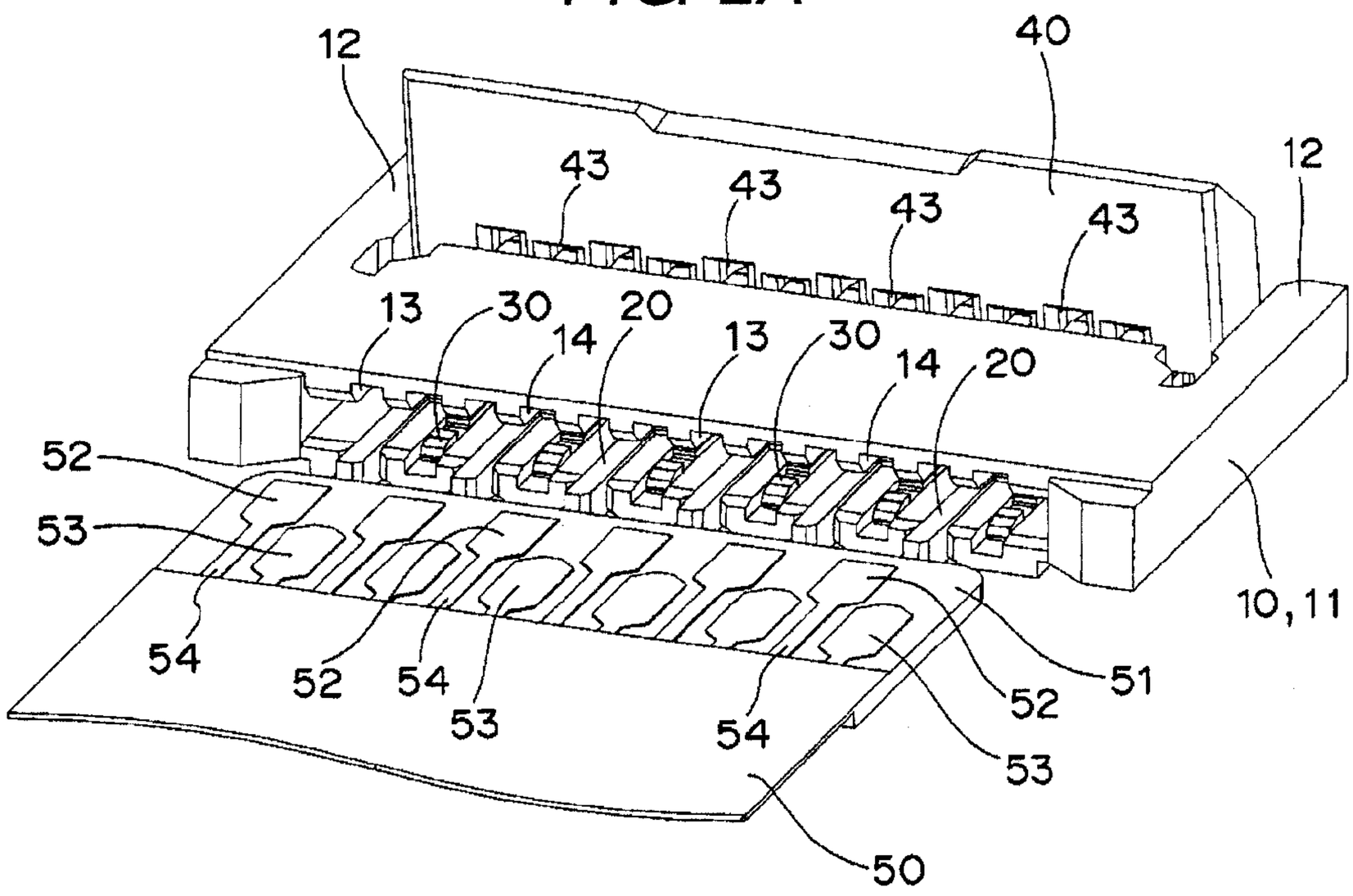

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FIG. 2B

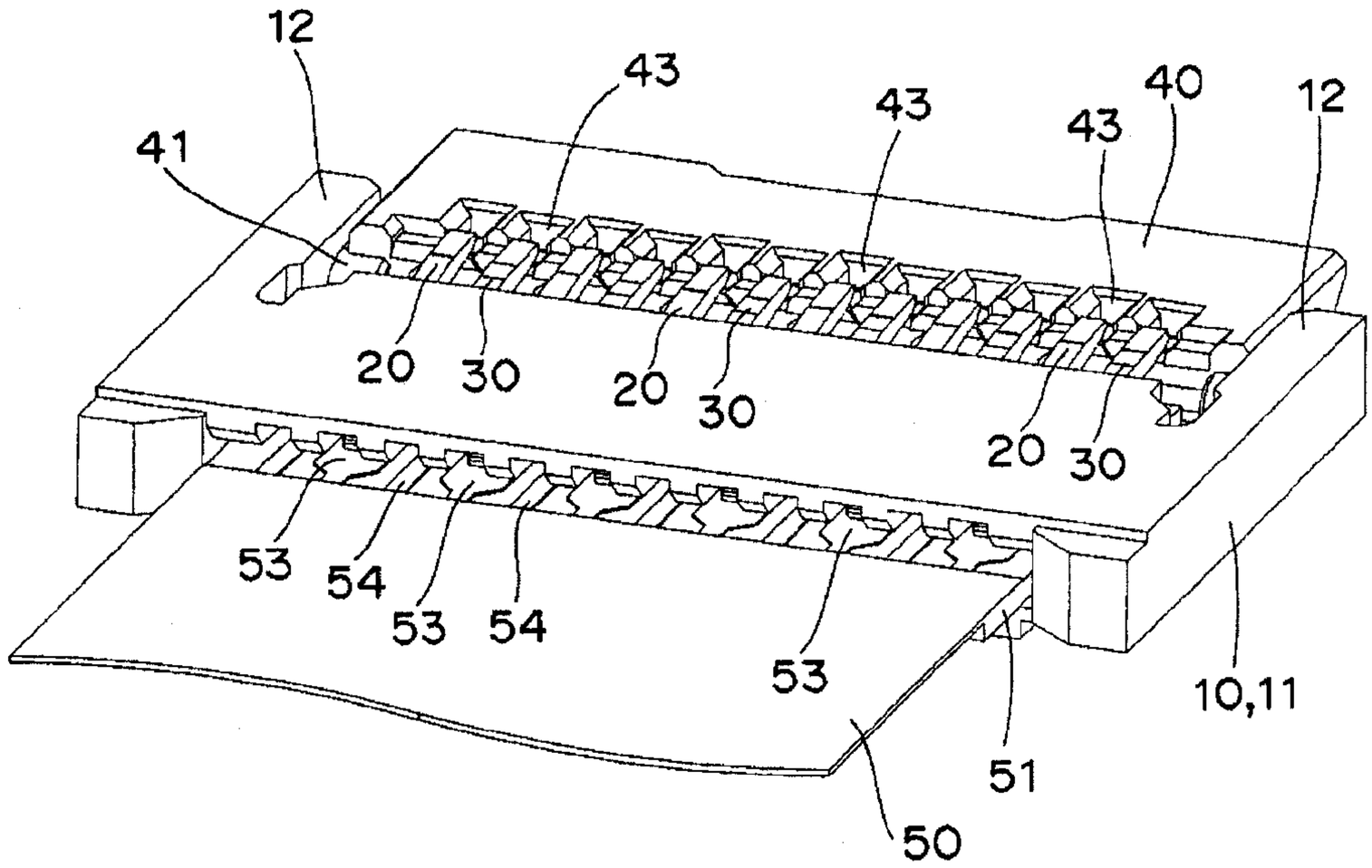
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FIG. 3

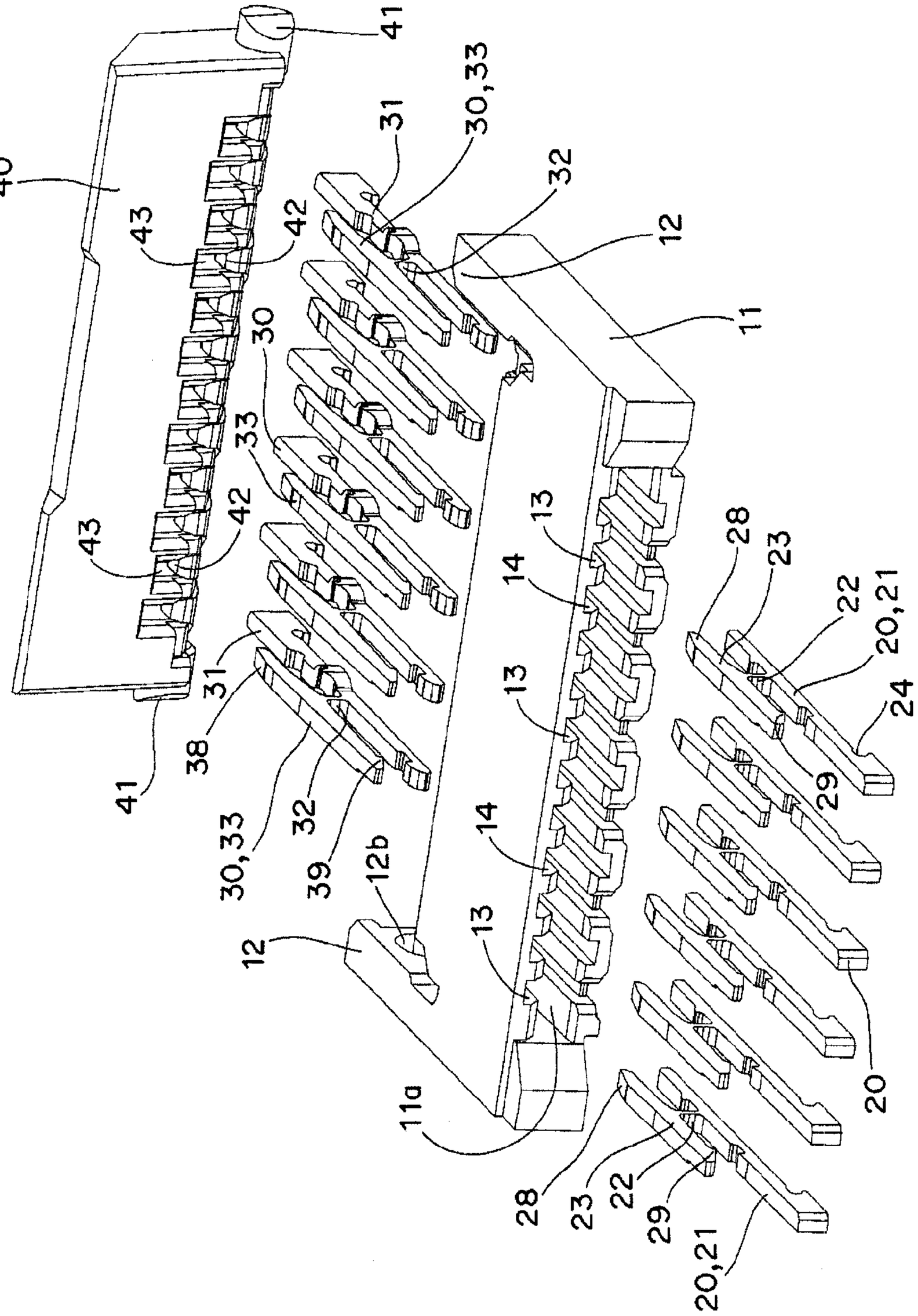
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FIG. 4A

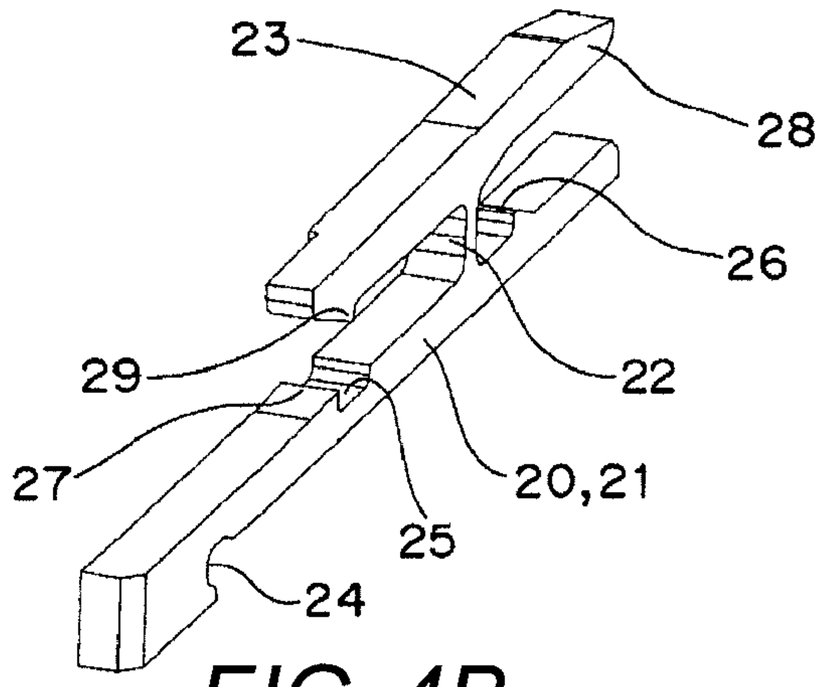

FIG. 4B

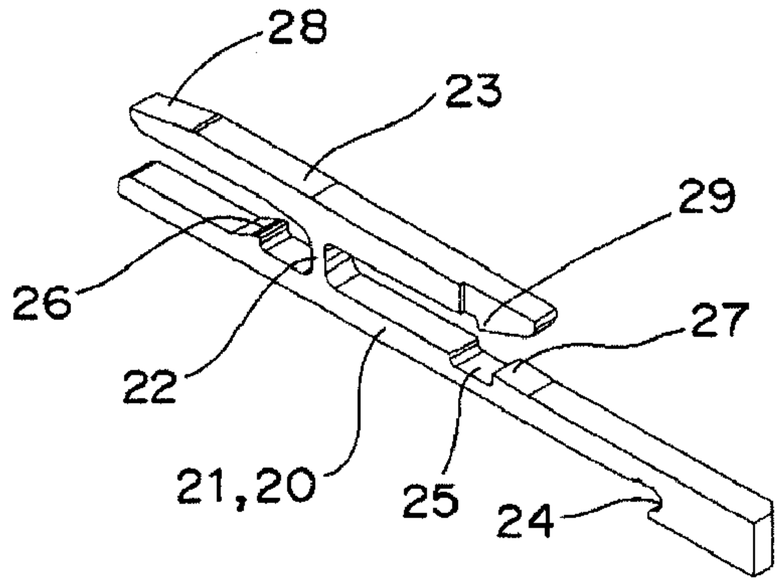

FIG. 4C

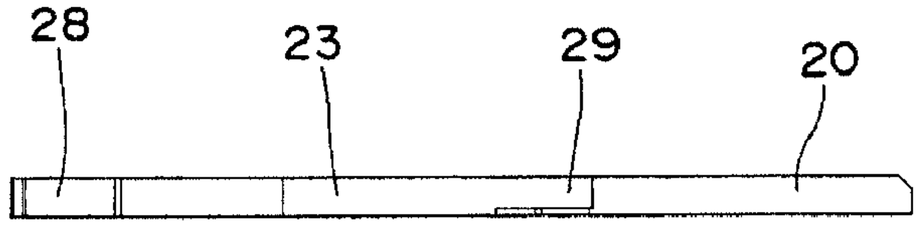

FIG. 4D

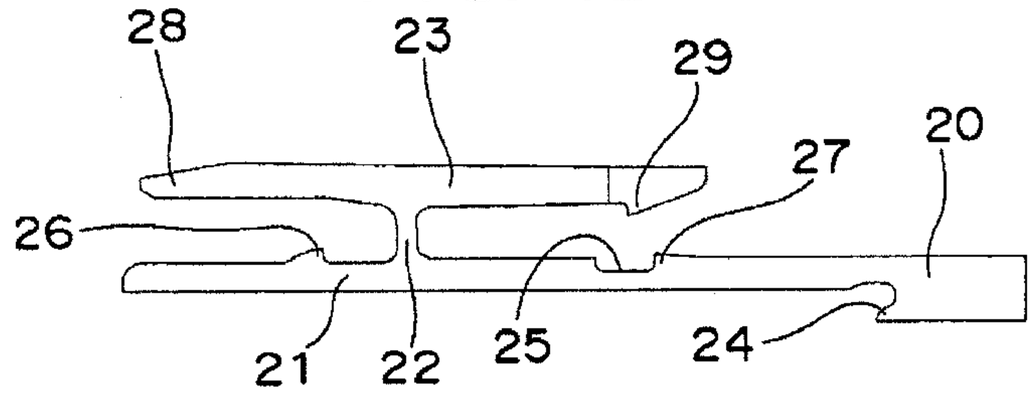

FIG. 4E

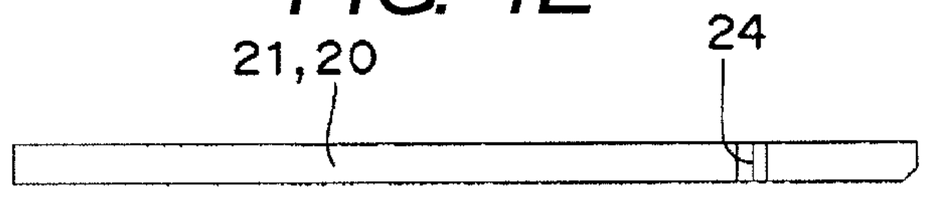

FIG. 5A

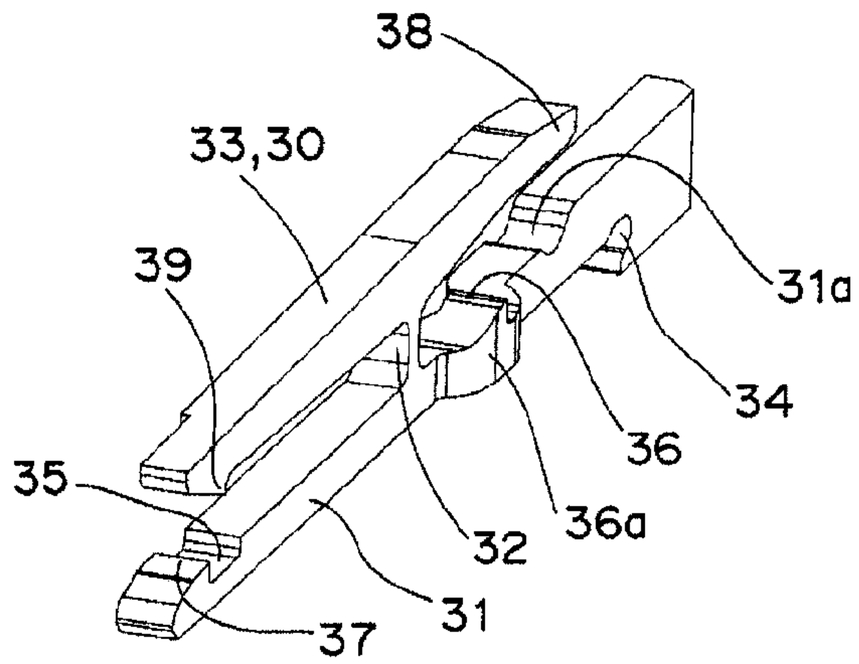

FIG. 5B

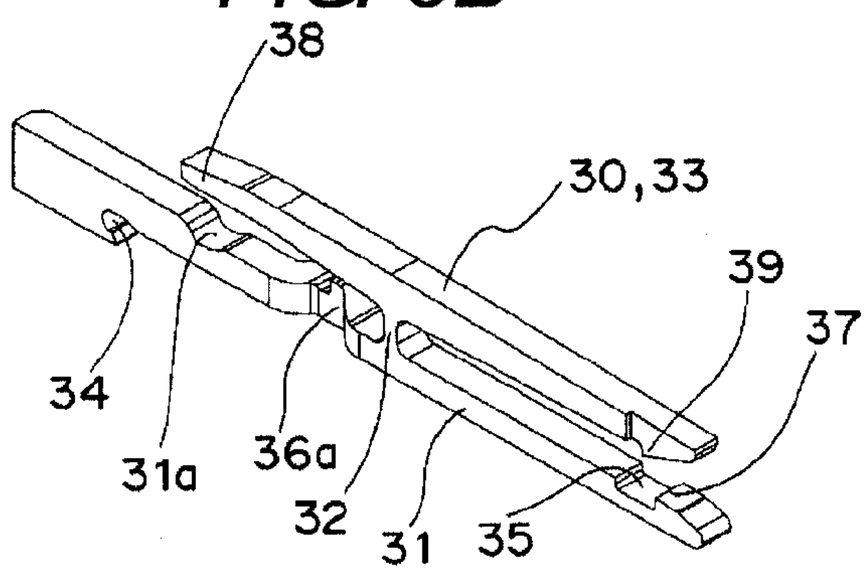

FIG. 5C

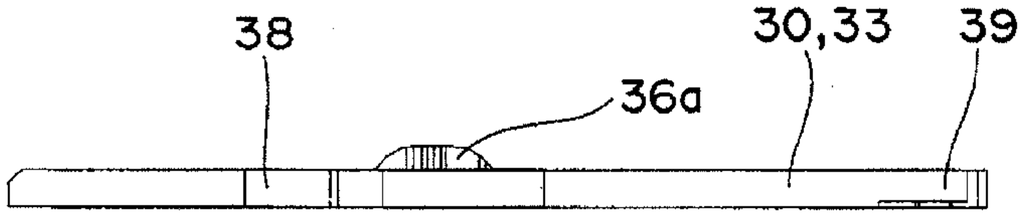

FIG. 5D

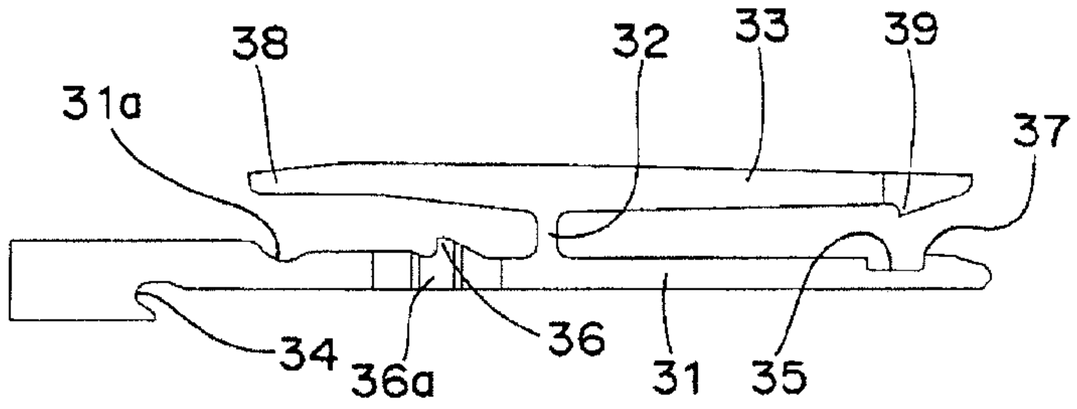

FIG. 5E

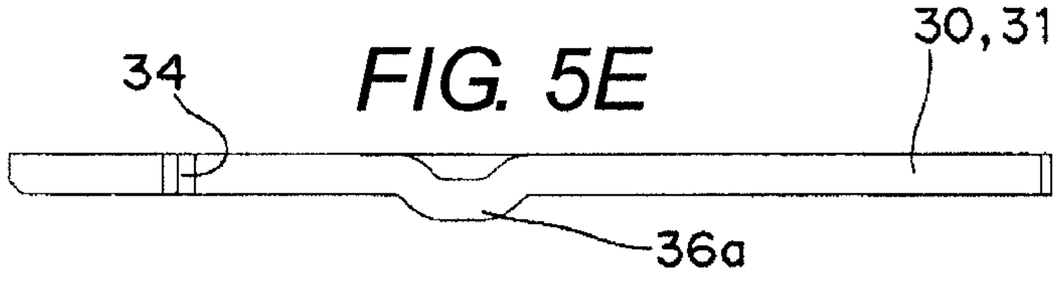

FIG. 6A

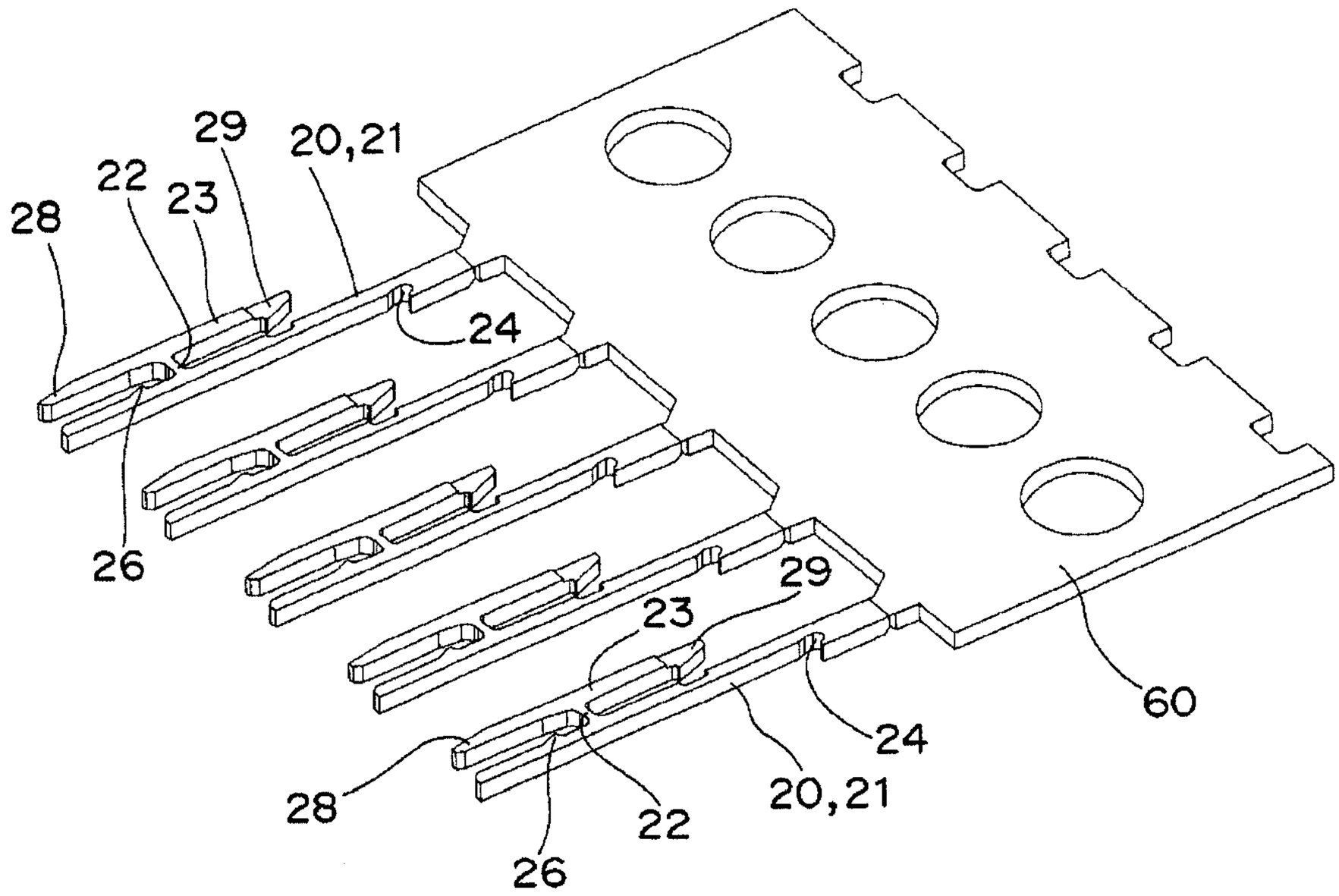
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FIG. 6B

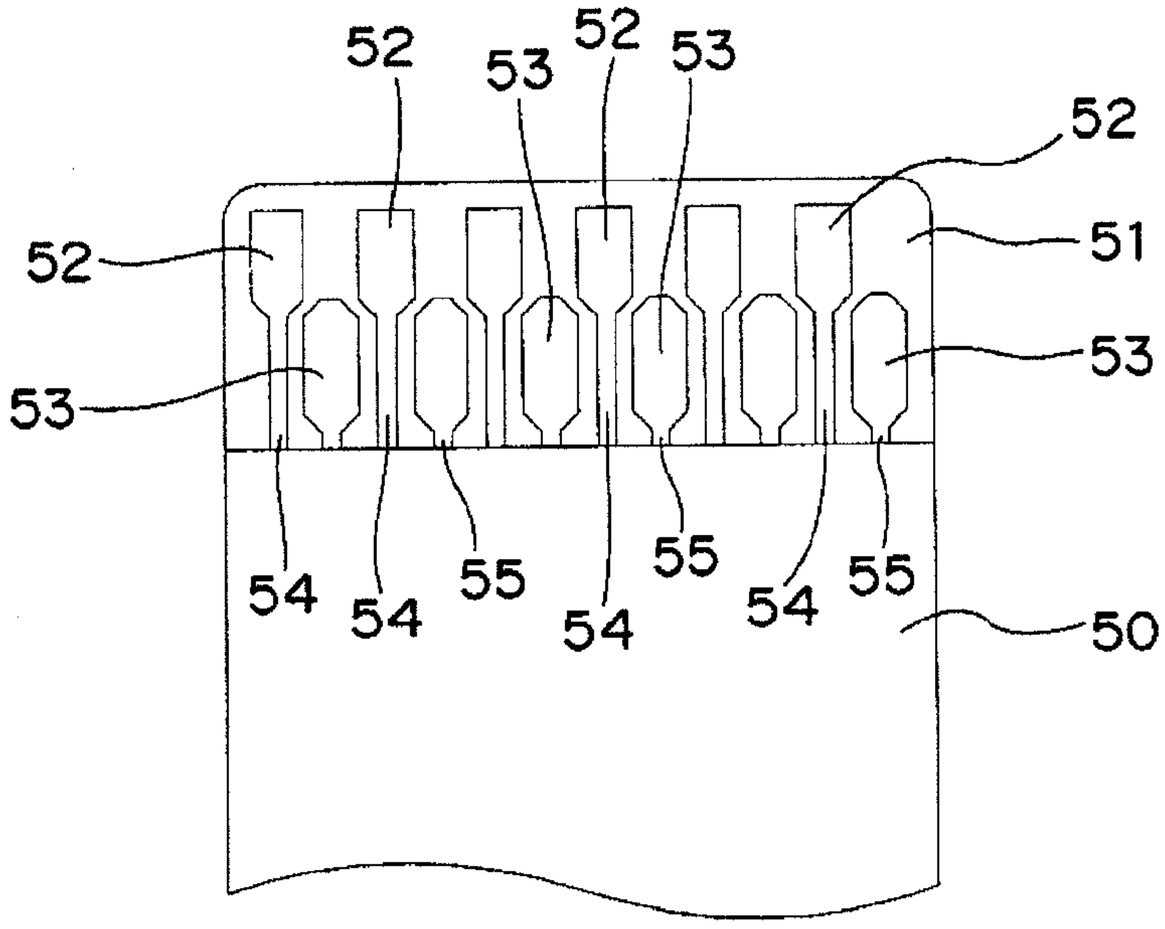
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FIG. 7A

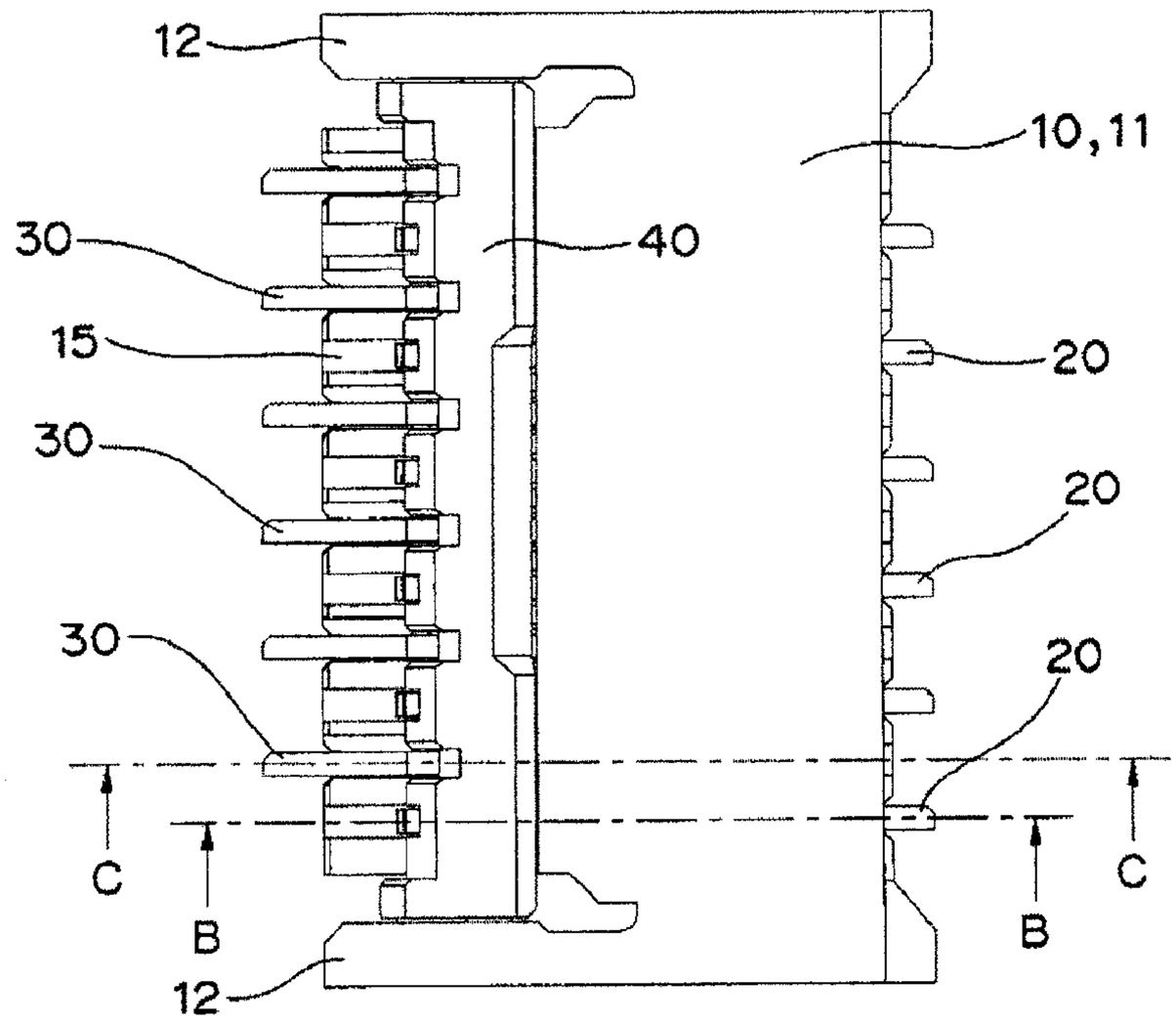


FIG. 7B

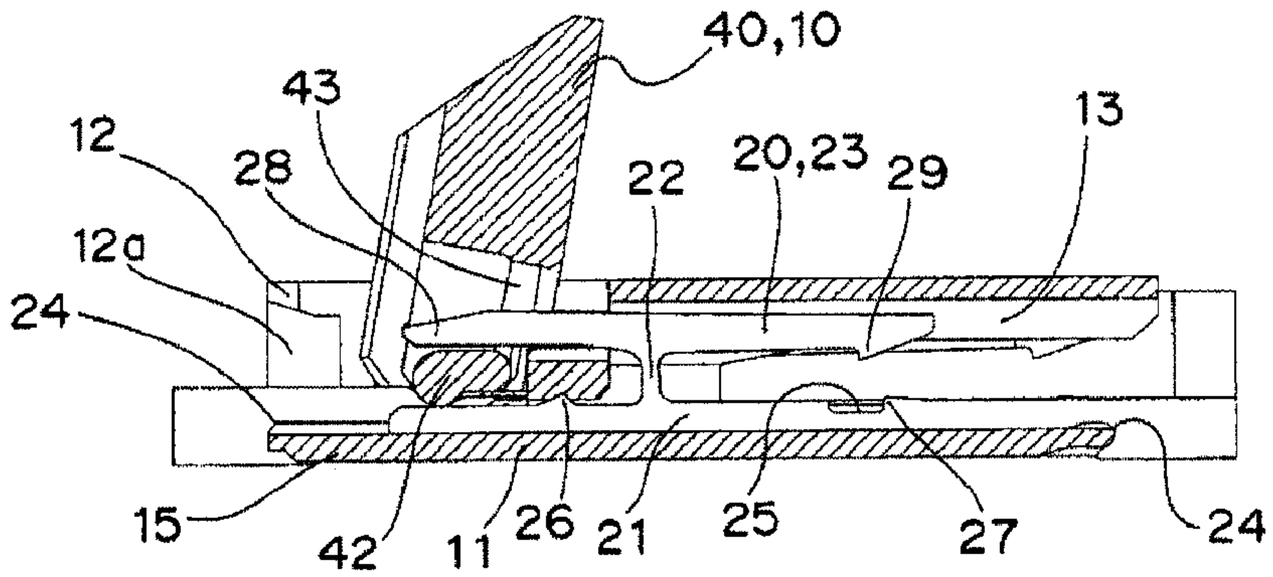


FIG. 7C

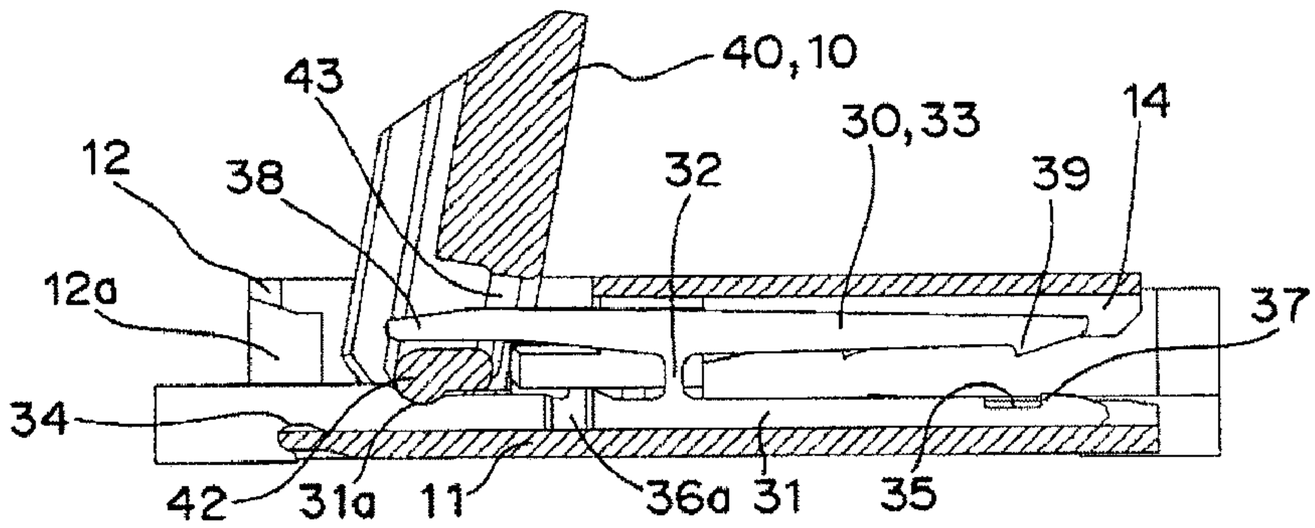


FIG. 8A

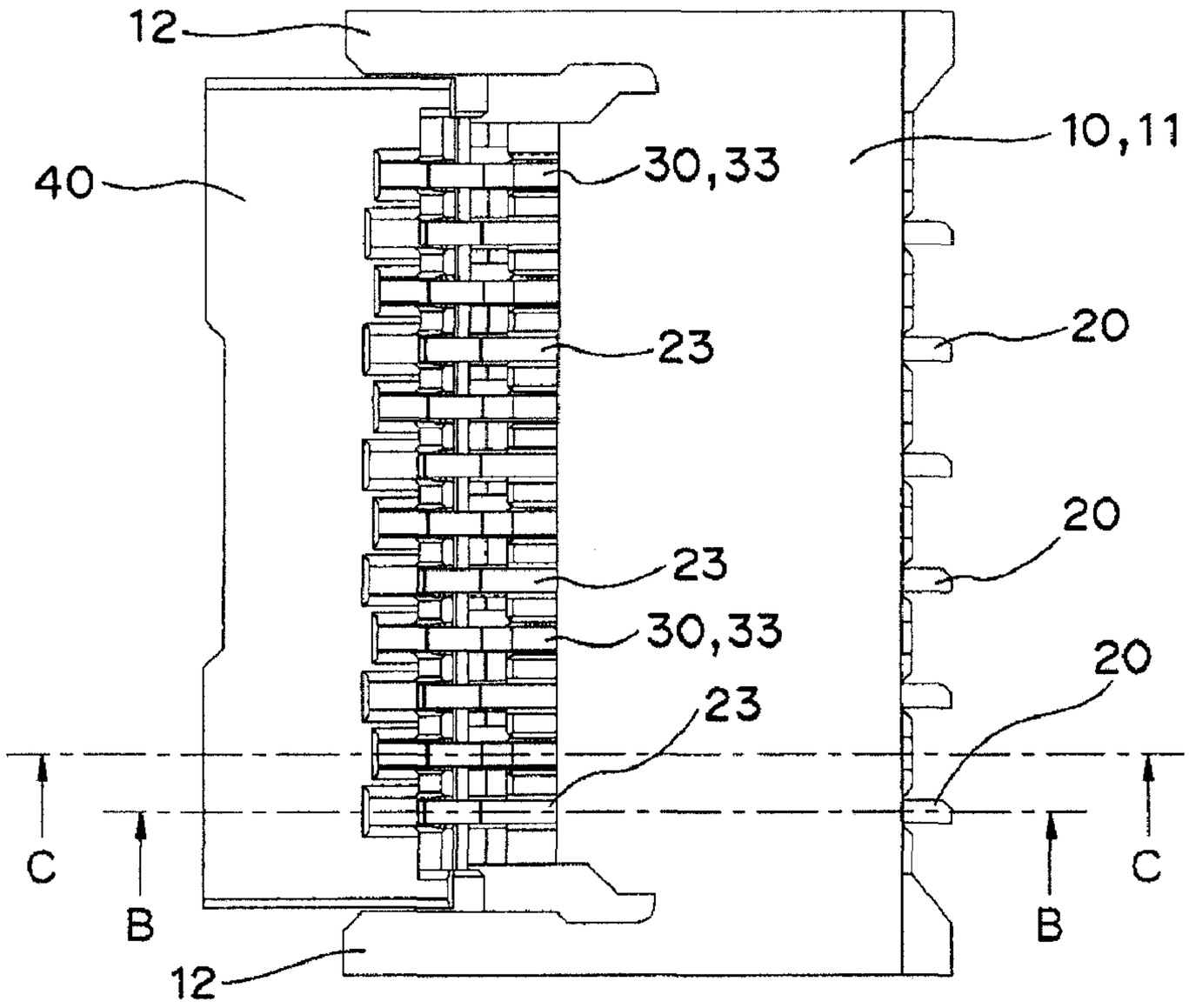


FIG. 8B

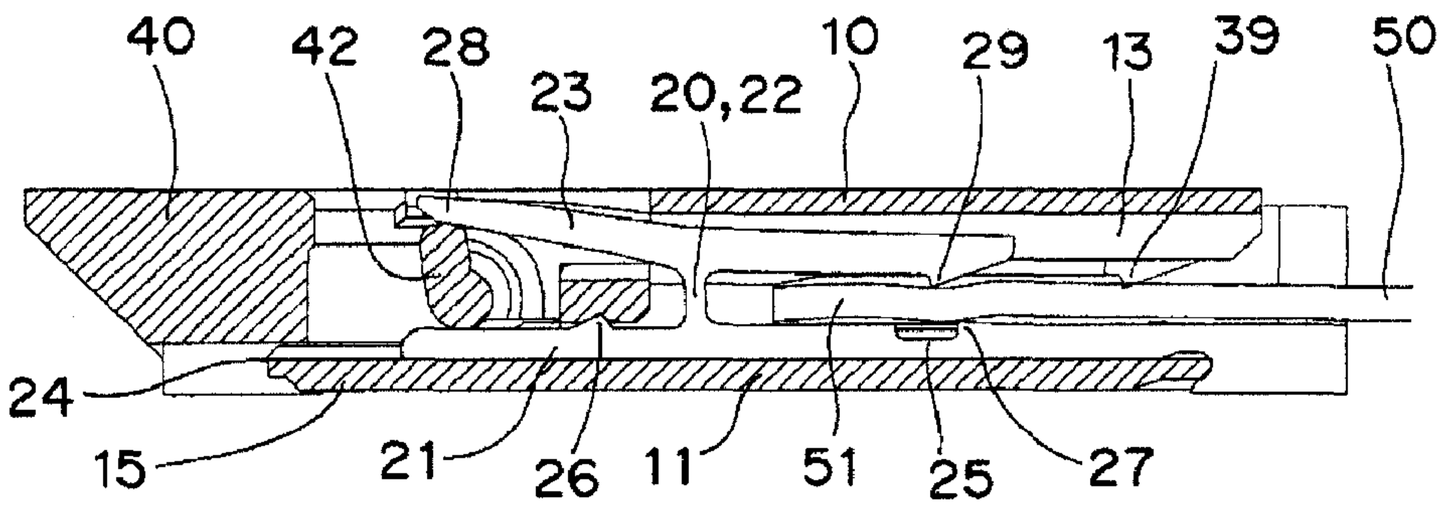


FIG. 8C

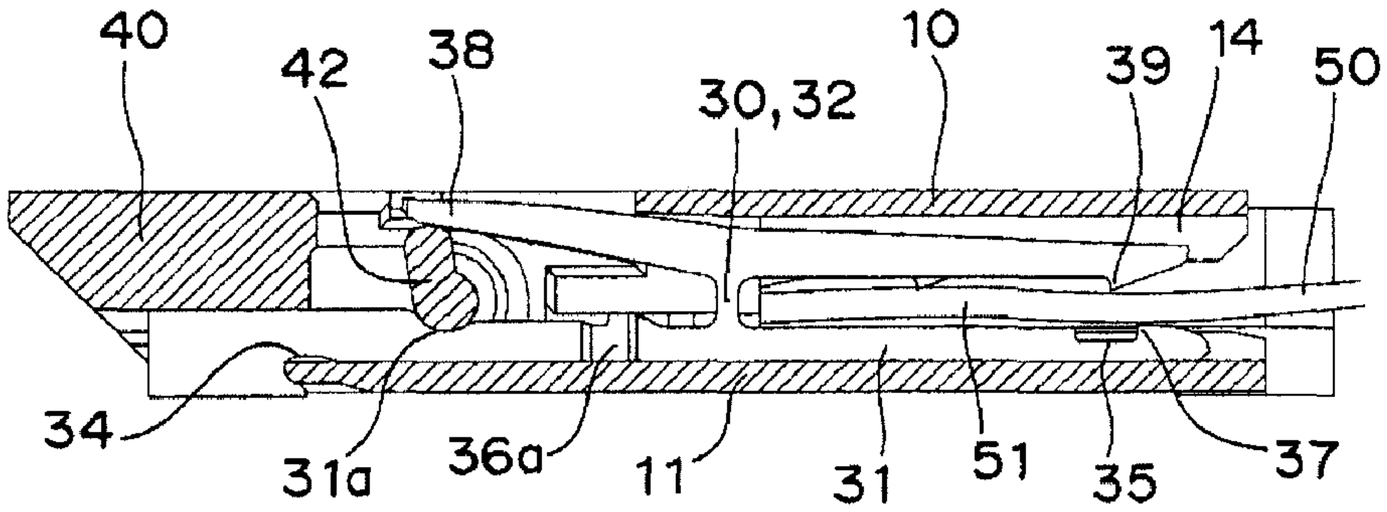


FIG. 9A

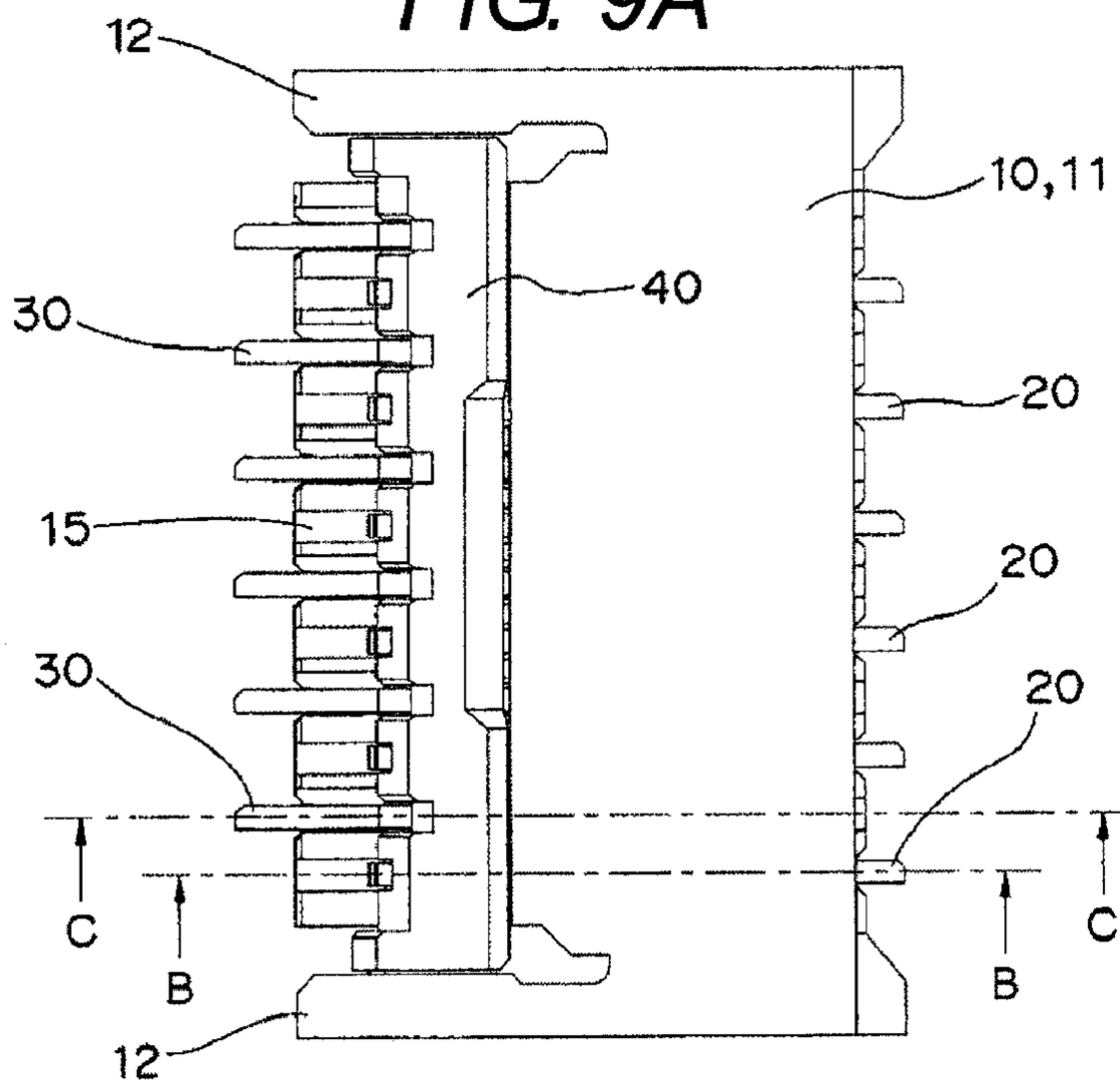


FIG. 9B

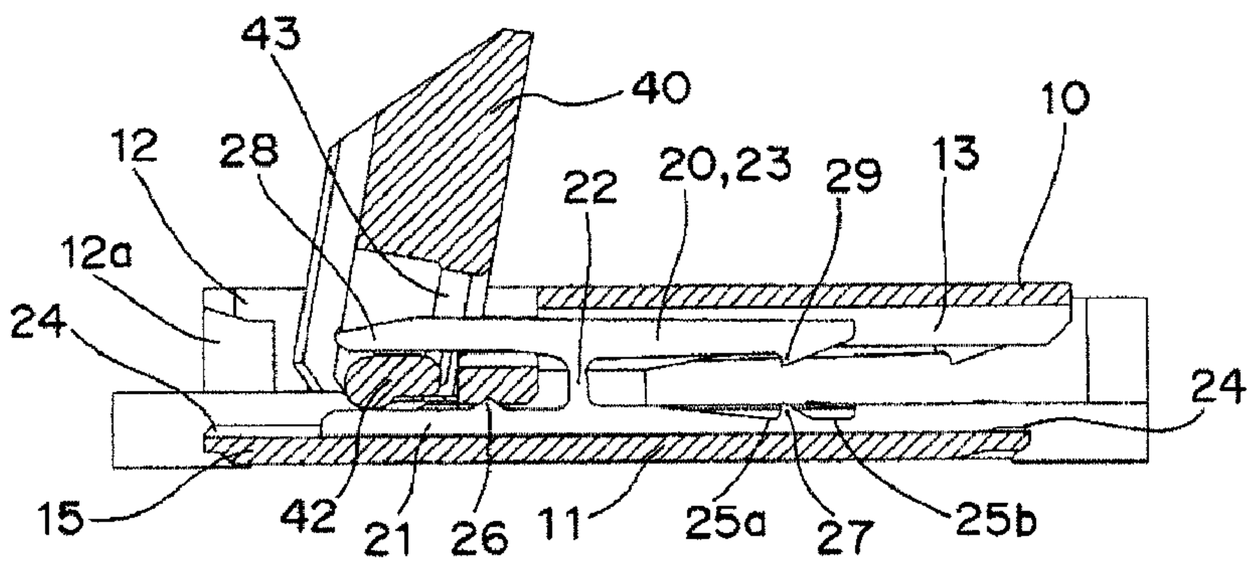


FIG. 9C

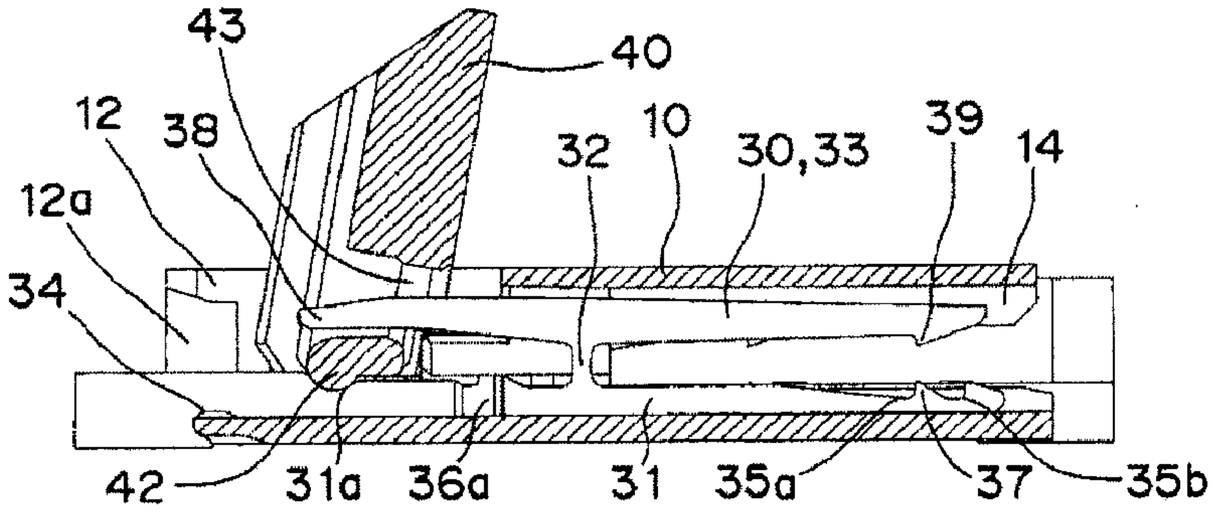


FIG. 10A

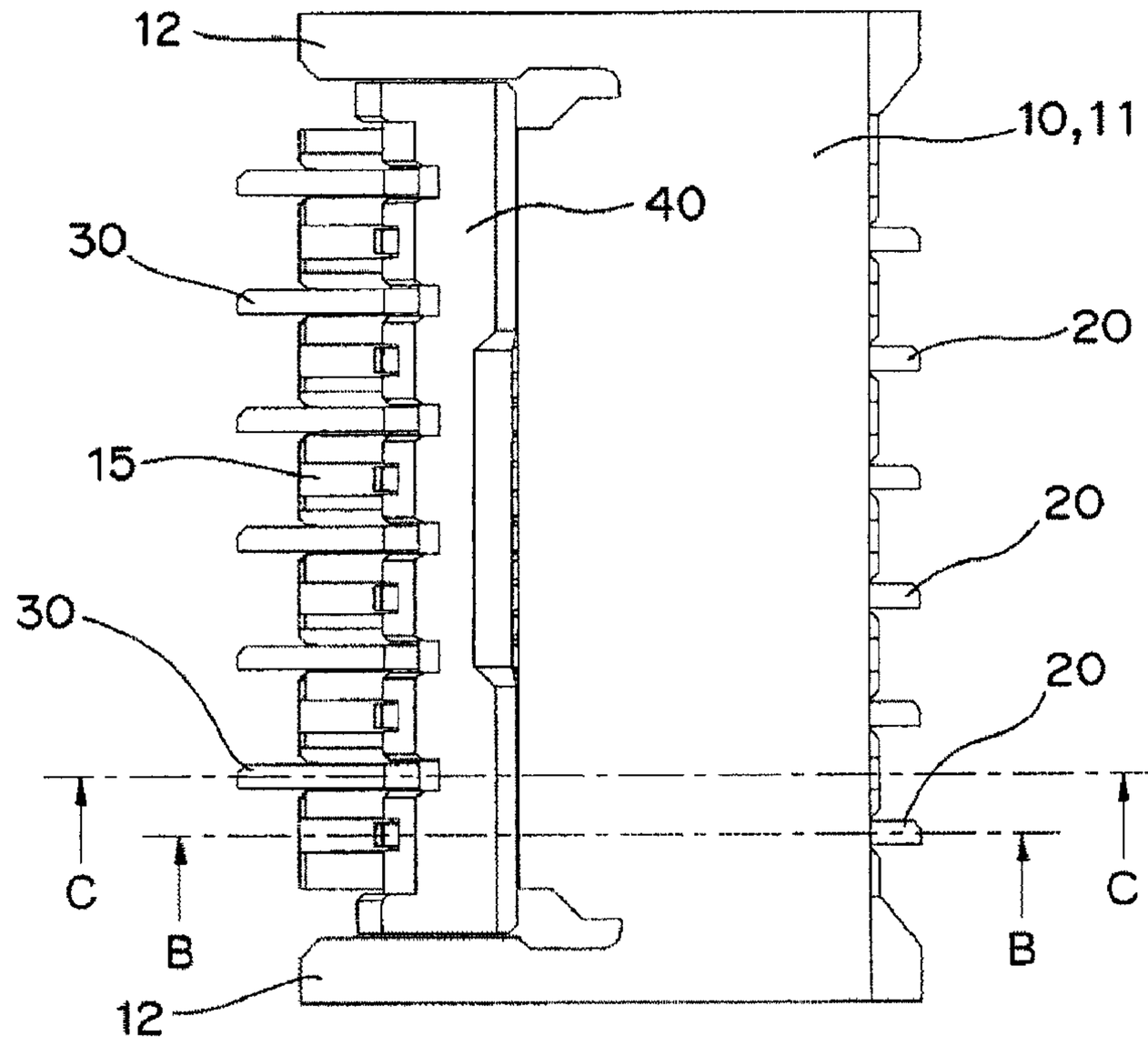


FIG. 10B

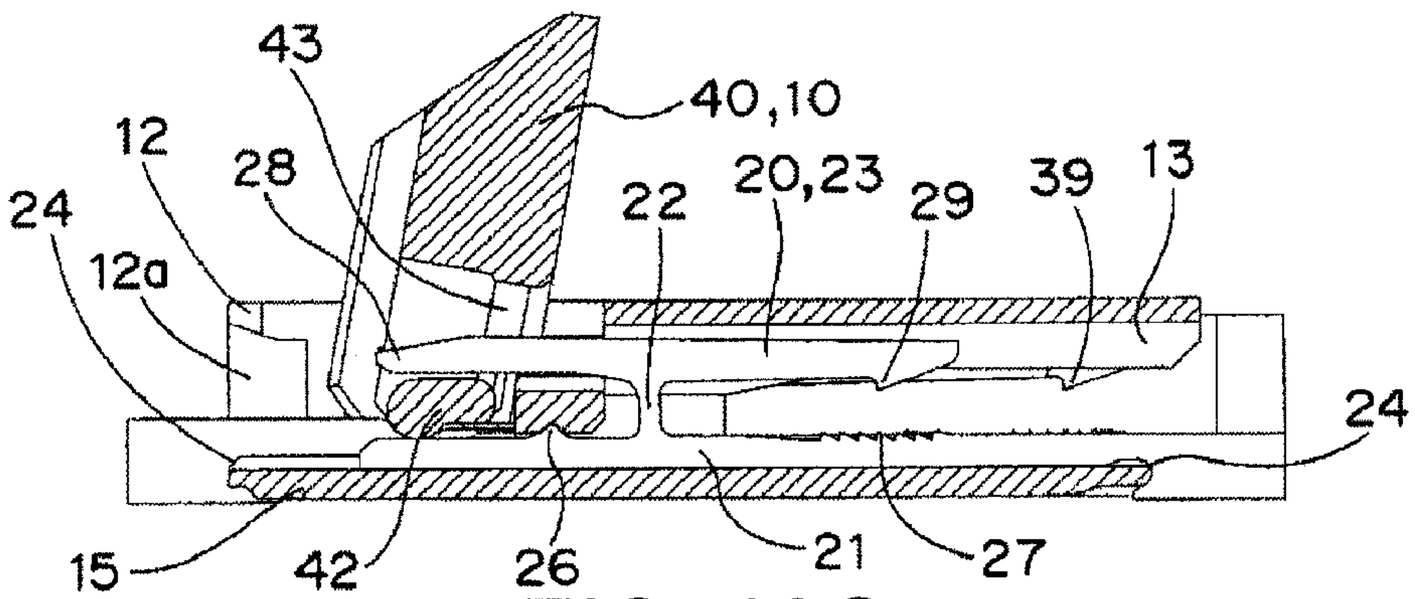


FIG. 10C

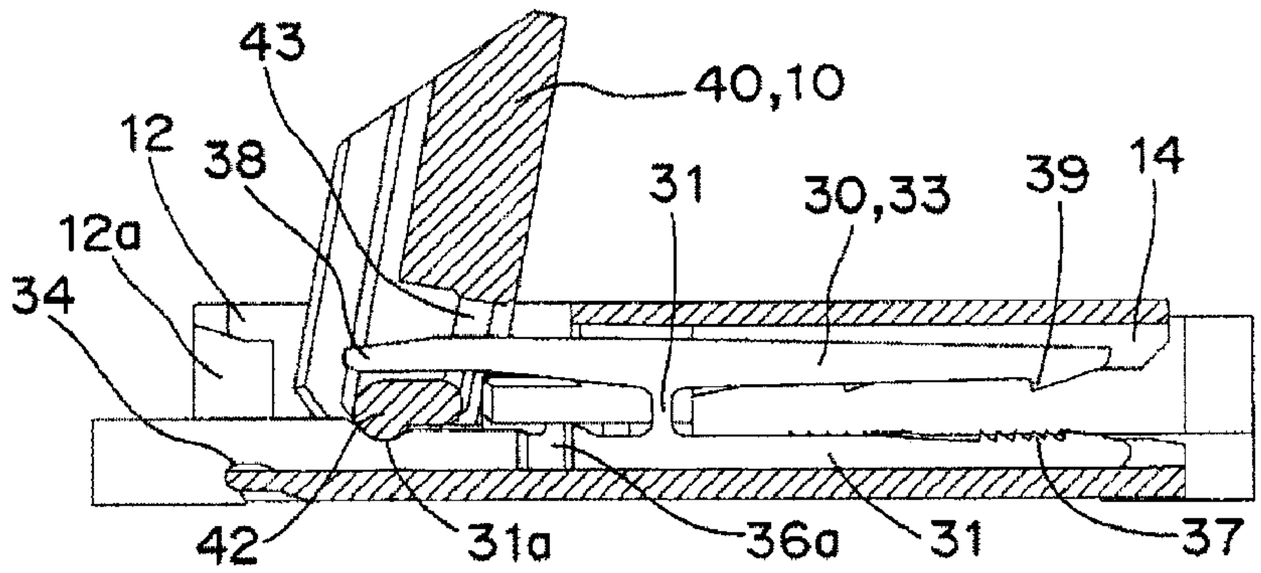


FIG. 11

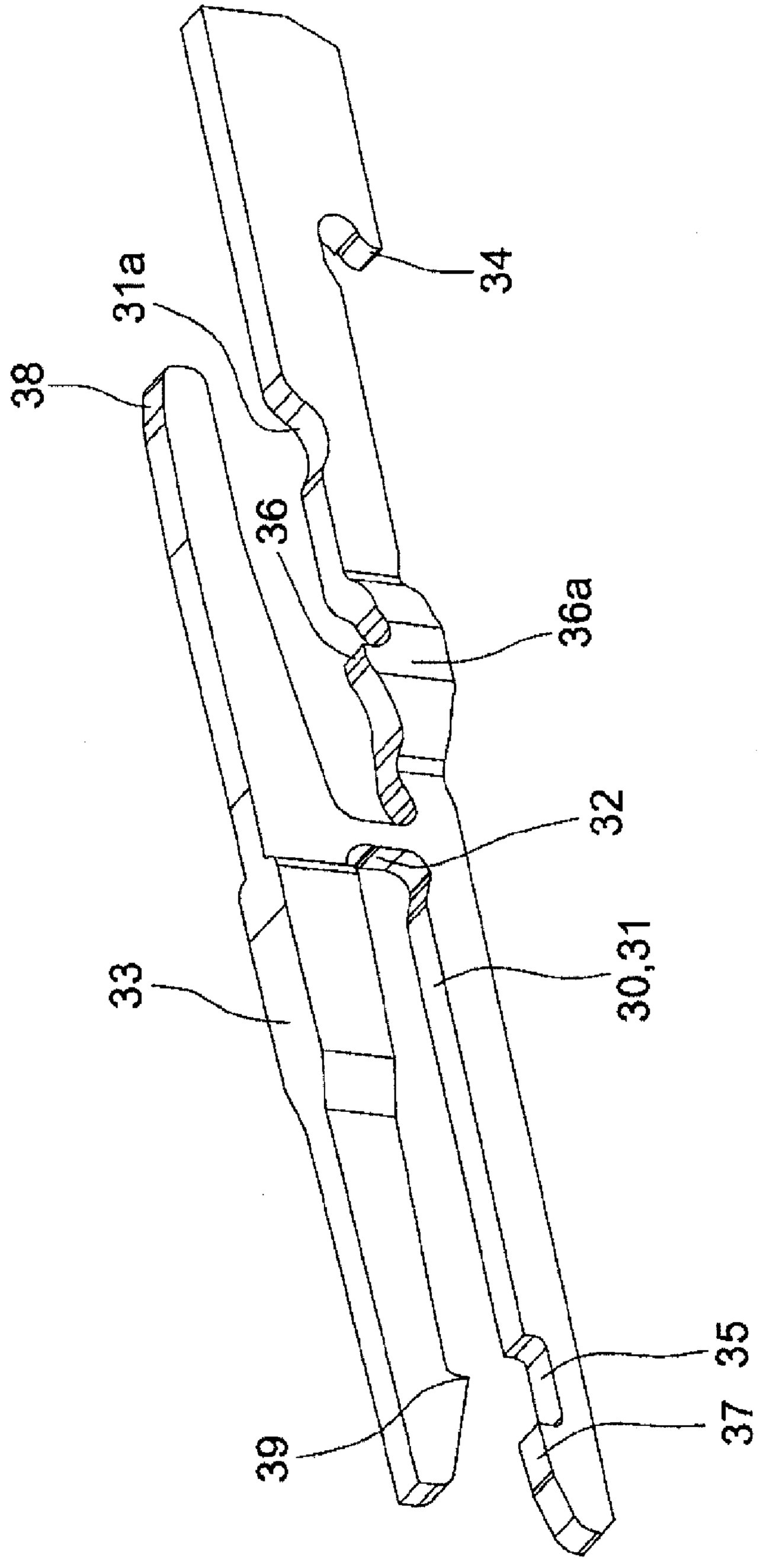


FIG. 12A

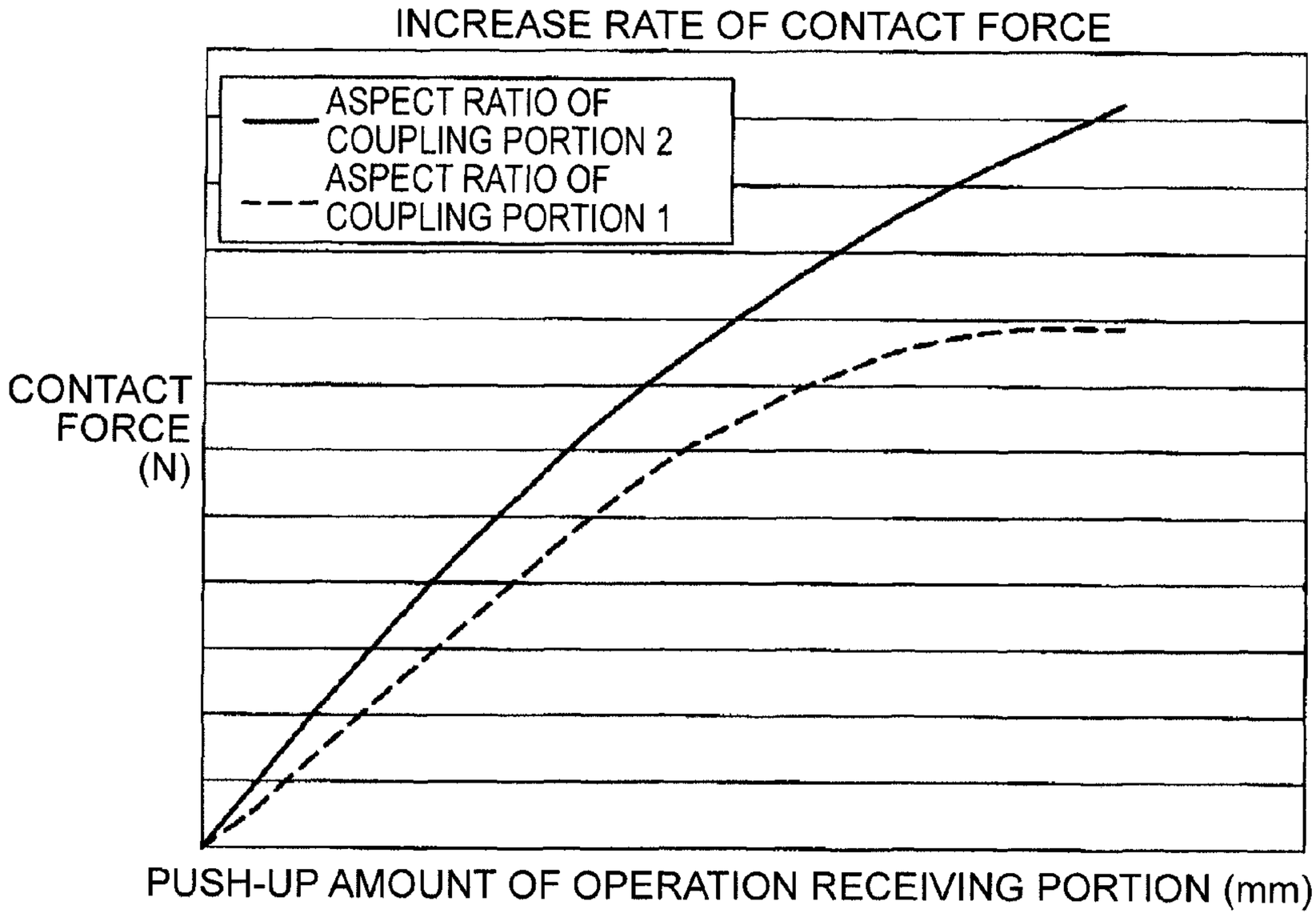


FIG. 12B

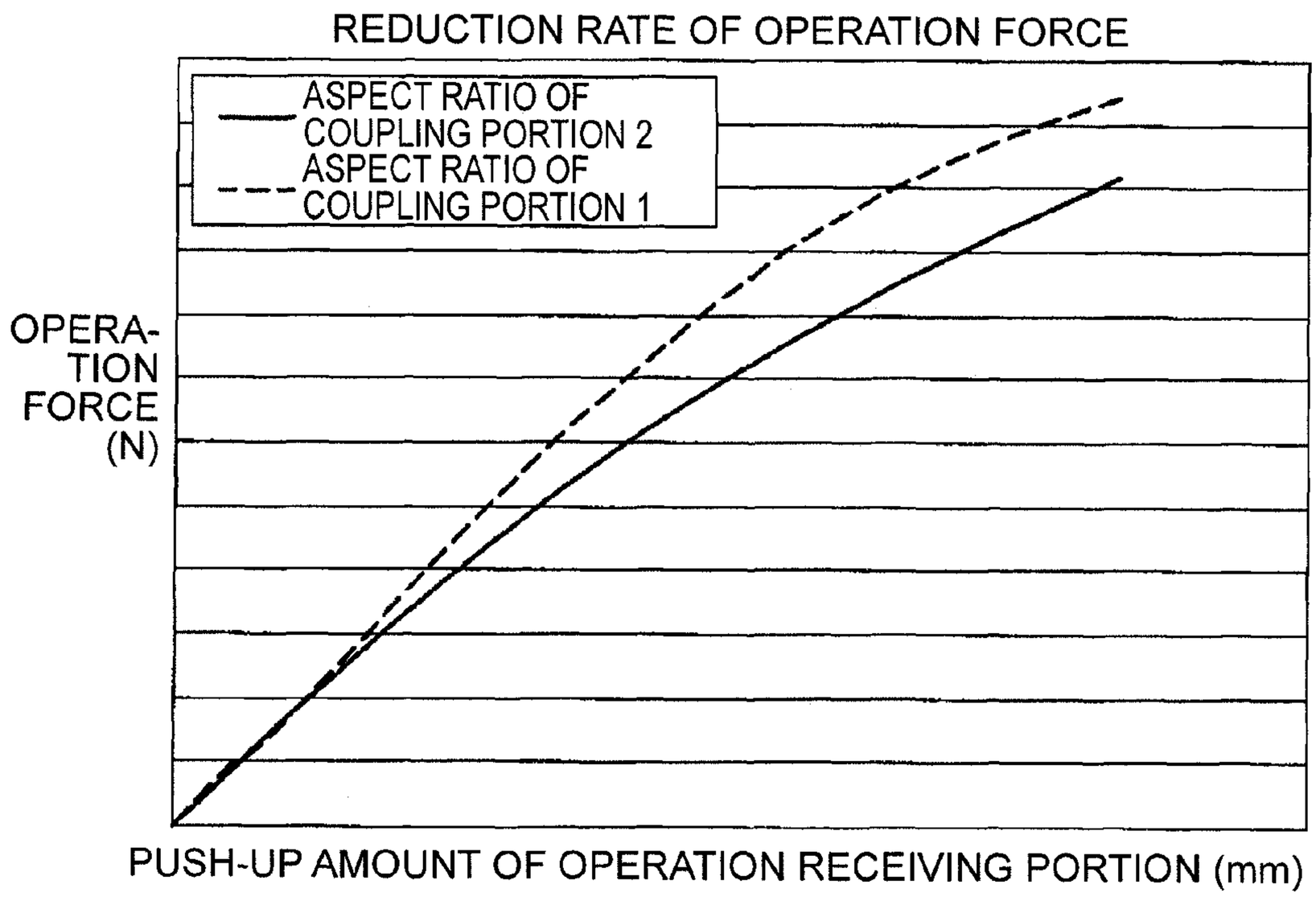
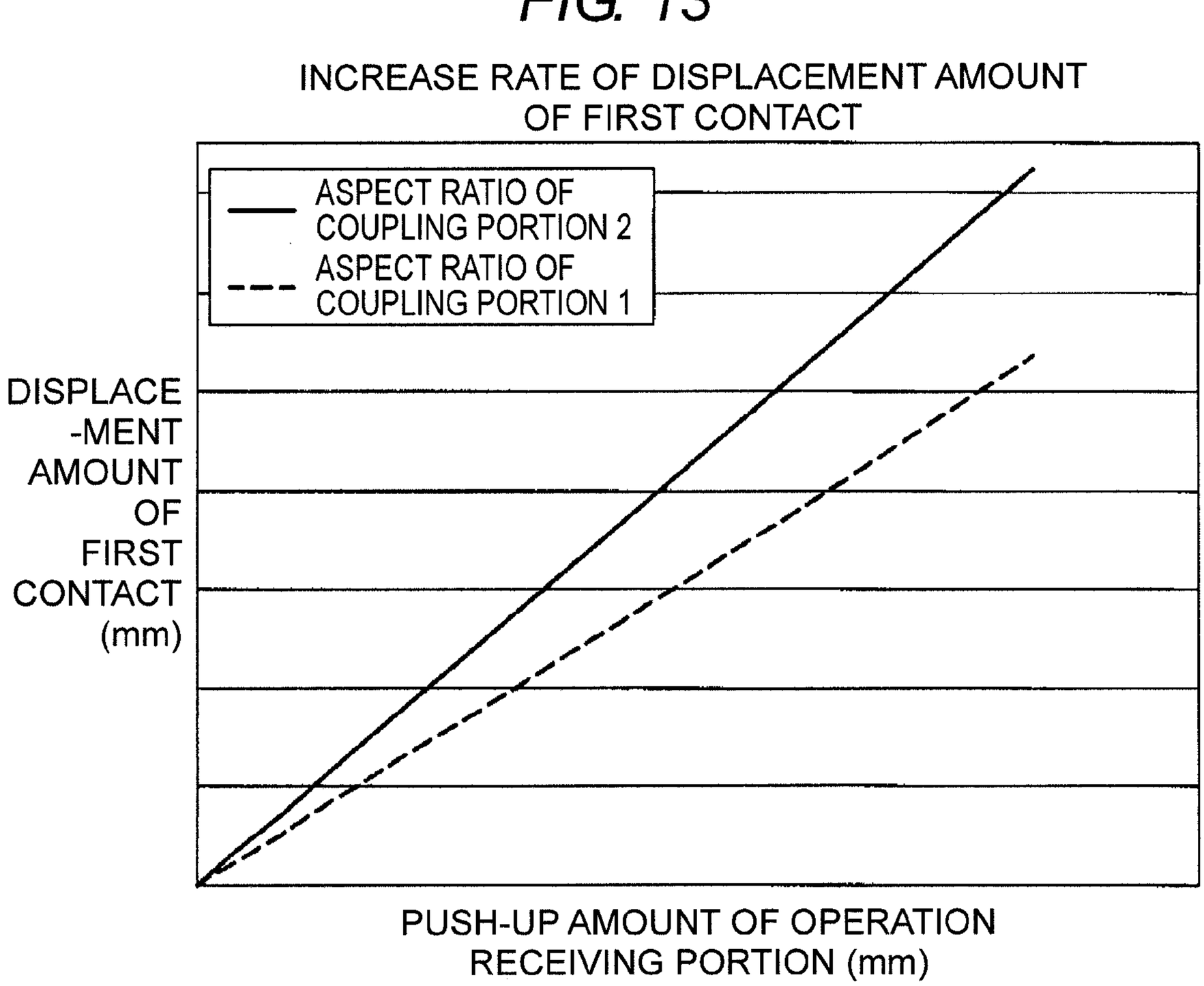


FIG. 13


INCREASE RATE OF DISPLACEMENT AMOUNT OF FIRST CONTACT
ASPECT RATIO OF COUPLING PORTION 2
ASPECT RATIO OF COUPLING PORTION 1
DISPLACE-MENT AMOUNT OF FIRST CONTACT (mm)
PUSH-UP AMOUNT OF OPERATION RECEIVING PORTION (mm)

CONNECTOR CONNECTION TERMINAL COMPRISING A POINTED PORTION FORMED THROUGH ELECTROFORMING AND CONNECTOR INCORPORATING THE SAME

BACKGROUND OF INVENTION

1. Technical Field

The present invention relates to connector connection terminals, and in particular, to a connector connection terminal for connecting a flexible print substrate.

2. Related Art

Conventionally, a connector connection terminal includes an electrical connector for connector connection terminal incorporated in a planar circuit substrate in which a terminal, which is obtained by processing a metal plate while maintaining a plate surface of the metal plate, is held in plurals by a housing with a spacing in a direction orthogonal to the plate surface, the terminal having a projection formed at the opposing edges of two arm bodies substantially parallel to each other, and the distance between the projections of the two arm bodies being elastically narrowed by applying an external force to the terminal to electrically connect a planar circuit substrate and the terminal while sandwiching the planar circuit substrate between the projections, where the projection of at least one of the arm bodies forms a sharp pointed portion (see Japanese Unexamined Patent Publication No. 2007-227302).

In recent years, the electrical connector is used in devices such as a portable telephone and a portable game machine, but further miniaturization is demanded on the electrical connector with miniaturization of these devices. For instance, in a certain electrical connector, the height dimension of the insulating housing is smaller than or equal to 1 mm, a conductive thin plate having a plate thickness of smaller than or equal to 0.2 mm is used for the connector connection terminal incorporated in the electrical connector, and great number of connector connection terminals are arranged in the housing at a pitch of between 0.3 and 0.5 mm.

With demands of further miniaturization and lowering in height on the electrical connector, further miniaturization and lowering in height are also demanded on the connector connection terminal incorporated in the electrical connector, and thus miniaturization and lower height are also relatively demanded on the sharp pointed portion of the connector connection terminal.

SUMMARY

However, there is a limit to lowering the height and miniaturizing the sharp pointed portion since the connector connection terminal is normally manufactured by punching out the conductive thin plate through press working. When attempting to form the sharp pointed portion through press working, the press operation step of at least two times is required, and the productivity is low.

One or more embodiments of the present invention provides a connector connection terminal in which the number of operation steps is few, the productivity is high, and miniaturization and lowering in height can be realized.

One or more embodiments of the present invention relates to a connector connection terminal including a fixed piece to be inserted to a base of a connector, a coupling portion extending from the fixed piece, and a movable piece extending in parallel to the fixed piece to both sides from a free end of the coupling portion and being operated by an operation lever

rotatably assembled to the base, wherein at least one of the fixed piece and the movable piece includes at least one pointed portion; and the connector connection terminal is formed through electroforming.

According to one or more embodiments of the present invention, since the pointed portion can be formed through electroforming, a connector connection terminal having a lowered height and being miniaturized can be obtained with few number of operation steps.

In one aspect of the present invention, the connector connection terminal formed with a cutout may be obtained.

According to such aspect, the height can be lowered and slip-out can be prevented by curving the flexible print substrate at the cutout, and thus high reliability is obtained.

In particular, as the edge on one side of the cutout is the pointed portion and the flexible print substrate is locked to the pointed portion, the height can be lowered while further enhancing the contact reliability.

In another aspect of the present invention, an aspect ratio of a cross-sectional area of a bottom of the cutout may be greater than or equal to 1.2.

According to such aspect, further lowering in height and miniaturization can be realized since the cross-sectional area of the bottom of the cutout can be thinned.

In another further aspect of the present invention, a plurality of pointed portions may be arranged side by side to form a saw-tooth shape.

According to such aspect, the positioning task of the flexible print substrate is facilitated since the flexible print substrate can be locked and connected with a plurality of pointed portions.

In still another aspect of the present invention, a thickness of the pointed portion may be thinner than a main body of the connector connection terminal.

According to such aspect, if a connection pad at the connection portion of the flexible print substrate is densely arranged side by side, the pointed portion does not contact the adjacent connection pad and the short circuit does not occur even if the positioning accuracy in the width direction of the connector connection terminal varies. Thus, the flexible print substrate does not require high positioning accuracy, and the connection task can be facilitated.

In particular, in another further aspect of the present invention, a step may be formed on one surface of the pointed portion for thinning, or a step may be formed on both surfaces of the pointed portion for thinning.

Since the step is merely formed on one surface of the pointed portion, the manufacturing is easy. The one-side contact of the pointed portion with respect to the flexible print substrate does not occur and the torsion moment does not act on the pointed portion by forming the step on both surfaces of the pointed portion.

Furthermore, the thickness of the pointed portion may be thinned by gradually reducing the thickness of the main body of the connector connection terminal.

According to such aspect, the manufacturing of the die of electroforming is facilitated than when forming a step at the pointed portion.

A connector according to one or more embodiments of the present invention has a configuration of incorporating the connector connection terminal, and operating the same with an operation lever.

According to one or more embodiments of the present invention, a miniaturized connector of lower height can be obtained by incorporating the miniaturized connector connection terminal of lower height to the base.

Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

FIGS. **1**A to **1**C are perspective views showing a connector incorporating a first embodiment of a connector connection terminal according to one or more embodiments of the present invention seen from different angles;

FIGS. **2**A and **2**B are perspective views showing before and after connection of the connector incorporating the connector connection terminal shown in FIGS. **1**A to **1**C;

FIG. **3** is an exploded perspective view of the connector shown in FIGS. **1**A to **1**C;

FIGS. **4**A to **4**E are a perspective view, a perspective view seen from a different angle, a plan view, a front view, and a bottom view of a first connection terminal shown in FIG. **3**;

FIGS. **5**A to **5**E are a perspective view, a perspective view seen from a different angle, a plan view, a front view, and a bottom view of a second connection terminal shown in FIG. **3**;

FIG. **6**A is a perspective view describing a manufacturing method of the first connection terminal, and FIG. **6**B is a partial plan view of a print substrate to be connected;

FIG. **7**A is a plan view showing before connection of the connector incorporating the connector connection terminal according to the first embodiment, and FIGS. **7**B and **7**C are cross-sectional views taken along the lines B-B and C-C, respectively, of FIG. **7**A;

FIG. **8**A is a plan view showing after connection of the connector incorporating the connector connection terminal according to the first embodiment, and FIGS. **8**B and **8**C are cross-sectional views taken along the lines B-B and C-C, respectively, of FIG. **8**A;

FIG. **9**A is a plan view showing a connector incorporating a connector connection terminal according to a second embodiment, and FIGS. **9**B and **9**C are cross-sectional views taken along the lines B-B and C-C, respectively, of FIG. **9**A;

FIG. **10**A is a plan view showing a connector incorporating a connector connection terminal according to a third embodiment, and FIGS. **10**B and **10**C are cross-sectional views taken along the lines B-B and C-C, respectively, of FIG. **10**A;

FIG. **11** is a perspective view showing a variant of the second connection terminal;

FIGS. **12**A and **12**B are graphs showing the operability of the connector connection terminal according to one or more embodiments of the present invention; and

FIG. **13** is a graph showing the operability of the connector connection terminal according to one or more embodiments of the present invention.

DETAILED DESCRIPTION

In embodiments of the invention, numerous specific details are set forth in order to provide a more thorough understanding of the invention. However, it will be apparent to one of ordinary skill in the art that the invention may be practiced without these specific details. In other instances, well-known features have not been described in detail to avoid obscuring the invention.

Hereinafter, preferred embodiments of the present invention will be described with reference to FIG. **1** to FIG. **11**.

As shown in FIG. **1** to FIG. **8**, the first embodiment is a case applied to a connector **10** for connecting a flexible print substrate **50**. The connector **10** broadly includes a base **11**, a first connection terminal **20**, a second connection terminal **30**, and an operation lever **40**.

As shown in FIGS. **1**A to **1**C, the base **11** has elastic arms **12**, **12** extending in parallel to the rear surface side from an edge on one side of both side end surfaces. In an inward surface of the elastic arm **12**, a guide tapered surface **12***a* is formed at a distal end edge and a bearing slit **12***b* is formed on the far side. The base **11** includes, on a front surface side, an opening **11***a* to which a distal end of the flexible print substrate **50**, to be hereinafter described, can be inserted, where a first insertion hole **13** passing from the front surface to the rear surface is arranged side by side at a predetermined pitch. The base **11** has a guide plate **15** extending between the elastic arms **12**, **12** from the edge on the lower side of the rear surface, and second insertion holes **14** arranged side by side at positions adjacent to the first insertion holes **13**.

As shown in FIGS. **4**A to **4**E, the first connection terminal **20** includes a fixed piece **21** to be inserted and fixed to the first insertion hole **13** of the base **11**, a coupling portion **22** arranged in a projecting manner at the upper side of the fixed piece **21**, and a movable piece **23** extending substantially parallel to the fixed piece **21** to both sides from the upper end of the coupling portion **22**, and has a thickness of 0.1 mm, for example.

The fixed piece **21** has a locking nail **24** for locking and positioning to the edge of the base **11** at one end on the lower side, and a cutout **25** and a slip-out preventing projection **26** on the upper side with the coupling portion **22** in between. A pointed portion **27** is formed by arranging the cutout **25**. The aspect ratio of the cross-sectional area of the bottom part of the cutout **25** is between 1.2 and 4, and preferably between 1.5 and 3. If smaller than 1.2, the desired pointed portion **27** is not easy to form, and if greater than 4, the desired strength is not obtained.

Through the formation of the first connection terminal **20** according to the present embodiment through electroforming, to be hereinafter described, the pointed end portion **27** of the desired angle can be manufactured with one electroforming step, so that a plurality of press operation steps are not necessary as in the press working.

The coupling portion **22** couples the fixed piece **21** with the movable piece **23** and rotatably supports the movable piece **23**, where the aspect ratio at the cross-sectional area thereof is between 1.2 and 4, and preferably between 1.5 and 3. If smaller than 1.2, a definite change is not found in the improvement of the operation force and the contact force, and if greater than 4, the desired durability is not obtained.

The manufacturing method of the first connection terminal **20** having such aspect ratio includes an electroforming method of simultaneously manufacturing a hoop material **60**, as shown in FIG. **6**A The electroforming method electrodeposits the metal to the portion not covered with an insulating film of the bottom surface of a cavity of a master block by applying voltage between the mother block (not shown) and the opposing electrode. When current is flowed, the metal also is electrodeposited on the insulating film covering one part of the bottom surface. In this case, the metal layer covering the insulating film grows with a delay from the metal layer electrodeposited on the portion not covered with the insulating film. That is, the irregular surface and the tapered surface of the first connection terminal **20** are formed by the irregularities of the cavity surface of the master block and the presence of the insulating film.

The material of the first connection terminal **20** is required not only to enable the desired shape and physicality to be obtained, but also that the electroforming solution is less

likely to be subjected to alteration. Thus, the material of the first connection terminal **20** may be nickel-silver alloy, nickel-tungsten alloy, nickel-cobalt alloy, nickel-palladium alloy, and the like in addition to copper elemental substance and nickel elemental substance.

The movable piece **23** has one end as an operation receiving portion **28** and the other side arranged with a first movable contact **29** projecting to the lower side. The first movable contact **29** has a pointed portion. The first movable contact **29** is arranged immediately above the cutout **25**, and the thickness dimension thereof is one step thinner than the thickness dimension of the entire movable piece **23**. This is because if the thickness dimension of the first movable contact **29** of the first connection terminal **20** is small, the first movable contact **29** is less likely to come in contact with a first connection pad **52** arranged at a connection portion **51** of the flexible print substrate **50** and a lead wire **54** of an adjacent second connection pad **53** shown in FIG. **6**B even if the assembly accuracy of the first connection terminal **20** varies, and the possibility of short circuit is reduced. Thus, high assembly accuracy is not required for the assembly task, and the productivity is enhanced.

The first movable contact **29** may not only be thinned by arranging a step difference on one surface and may be thinned by arranging a step difference on both surfaces, or the width dimension of the first movable contact **29** may be gradually thinned by forming a tapered surface.

As shown in FIGS. **5**A to **5**E, the second connection terminal **30** includes a fixed piece **31** to be inserted to and fixed to the second insertion hole **14** of the base **11**, a coupling portion **32** arranged in a projecting manner at the upper side of the fixed piece **31**, and a movable piece **33** extending substantially parallel to the fixed piece **31** to both sides from the upper end of the coupling portion **32**.

The manufacturing method, the material, and the thickness of the second connection terminal **30** are similar to the first connection terminal **20**, and thus the description thereof will not be given.

The fixed piece **31** has a locking nail **34** for locking and positioning to the edge of the base **11** at one end on the lower side, and a cutout **35** and a slip-out preventing projection **36** on the upper side with the coupling portion **32** in between. A pointed portion **37** is formed by arranging the cutout **35**. The slip-out preventing projection **36** is formed on a bulging portion **36***a* bulging out in the plate thickness direction.

The aspect ratio of the cross-sectional area of the bottom part of the cutout **35** is between 1.2 and 4, and preferably between 1.5 and 3. If smaller than 1.2, the desired pointed end portion is not easy to form, and if greater than 4, the desired strength is not obtained. The second connection terminal **30** having such aspect ratio is manufactured through the electroforming method, similar to the first connection terminal **20**.

The coupling portion **32** couples the fixed piece **31** with the movable piece **33** and rotatably supports the movable piece **33**, where the aspect ratio at the cross-sectional area thereof is between 1.2 and 4, and preferably between 1.5 and 3. If smaller than 1.2, a definite change is not found in the improvement of the operation force and the contact force, and if greater than 4, the desired durability is not obtained.

The movable piece **33** has one end as an operation receiving portion **38** and the other end arranged with a second movable contact **39** projecting to the lower side. The second movable contact **39** has a pointed portion. The second movable contact **39** is arranged immediately above the cutout **36**.

The second connection terminal **30** does not necessarily need to have a uniform thickness, and the vicinity of the coupling portion **32** of the movable piece **33** may be formed thicker than other portions as shown in FIG. **11**. According to the present embodiment, the second moment of area of the movable piece **33** becomes large and the rigidity becomes large, and thus a large contact force is obtained.

Although not shown in FIG. **11**, the fixed piece **31** may also not have a uniform thickness, and only the bulging portion **36***a* may be formed thick. According to the present embodiment, the entire second connection terminal **30** is less likely to slip out, and the holding strength is enhanced.

As shown in FIG. **3**, the operation lever **40** has turning shaft parts **41**, **41** arranged in a projecting manner on the same axis center on both side end surfaces. The operation lever **40** has a cam portion **42** for operating the operation receiving portions **28**, **38** of the first and second connection terminals **20**, **30** arranged at a predetermined pitch on the edge on one side, and a through-hole **43** to which the operation receiving portions **28**, **38** are inserted is arranged at a position corresponding to the cam portion **42**.

As shown in FIG. **6**B, the flexible print substrate **50** to be connected to the connector **10** according to the present embodiment has first and second connection pads **52**, **53**, which are print wired on the upper surface of the distal end **51**, alternately arranged in a zigzag manner. Lead wires **54**, **55** are connected to the first and second connection pads **52**, **53**.

The assembly method of the configuring parts described above will now be described.

First, one end of the first connection terminal **20** is inserted to the first insertion hole **13** from the opening **11***a* on the front surface side of the base **11**. The slip-out preventing projection **26** of the first connection terminal **20** thus locks to the roof surface of the slip-out preventing portion of the base **11**, and the locking nail **24** locks to and is positioned at the edge of the base **11** (FIGS. **7**A to **7**C).

The one end of the second connection terminal **30** is inserted to the second insertion hole **14** along the guide plate **15** of the base **11**. Thus, the slip-out preventing projection **36** arranged on the bulging portion **36***a* of the second connection terminal **30** locks while pushing and spreading in the up and down direction. At the same time, the locking nail **34** locks to and is positioned at the edge of the base **11**.

The operation receiving portions **28**, **38** of the first and second connection terminals **20**, are inserted to the through-holes **43** of the operation lever **40**, the operation lever **40** is slipped along the upper surface of the fixed piece **31** of the second connection terminal **30**, and the operation receiving portions **28**, **38** are pushed up and pushed in while being elastically deformed with the cam portion **42**. Therefore, the cam portion **42** is fitted to a bearing portion **31***a* of the second connection terminal **30**, and the turning shaft part **41** is fitted to the bearing slit **12***b* of the base **11**, whereby the operation lever **40** is rotatably supported.

The method of connecting and fixing the flexible print substrate **50** to the connector **10** will be described based on FIGS. **2**A, **2**B and FIGS. **8**A to **8**C.

As shown in FIGS. **2**A and **2**B, the connection portion **51** of the flexible print substrate **50** is inserted to the opening **11***a* of the base **11** until hitting the inner side surface of the base **11**. When the operation lever **40** is turned and pushed down with the axis center of the turning shaft part **41** as the center, the cam portion **42** simultaneously pushes up the operation receiving portions **28**, **38** of the first and second connection terminals **20**, **30**, as shown in FIGS. **8**A to **8**C. Thus, the movable pieces **23**, **33** tilt with the coupling portions **22**, **32** as the supporting point, and the first and second movable contacts **29**, **39** pressure contact and conduct with the first and second pads **52**, **53** arranged at the connection portion **51** of the flexible print substrate **50**.

In the present embodiment, the first and second movable contacts **29**, **39** not only push down and curve the connection portion **51** of the flexible print substrate **50**, but the first and second movable contacts **29**, **39** and the pointed portions **27**, **37** respectively bite into the front and back surfaces of the flexible print substrate **50** and prevent slipping out, so that high contact reliability can be ensured.

When detaching the flexible print substrate **50** from the connector **10**, the cam portion **42** is inverted by turning the operation lever **40** in the opposite direction, and the bending moment on the operation receiving portions **28**, **38** of the first and second connection terminals **20**, **30** is released. After releasing the connection state of the first and second movable contacts **29**, **39** with respect to the first and second connection pads **52**, **53**, the flexible print substrate **50** is pulled out.

According to the present embodiment, since the first and second connection pads **52**, **53** of the flexible print substrate **50** are arranged in a zigzag manner, as shown in FIG. **6**B, the mounting density becomes higher, miniaturization is more easily realized, and the contact reliability is enhanced.

The first and second movable contacts **29**, **39** of the first and second connection terminals **20**, **30** have a narrow width. Thus, even if the assembly accuracy varies, the second movable contact **39** of the second connection terminal **30** is less likely to come in contact with the lead wire **54** of the first connection portion **52** and the second connection portion **53** of the flexible print substrate **50**, and short circuit is less likely to occur.

As shown in FIGS. **9**A to **9**C, a second embodiment is a case in which the pointed portions **27**, **37** are formed by arranging a pair of cutouts **25***a*, **25***b*, and **35***a*, **35***b* on the upper side of the fixed pieces **21**, **31** of the first and second connection terminals **20**, **30**. Others are similar to the first embodiment described above, and thus the description thereof will not be given.

According to the present embodiment, the pointed end portions **27**, **37** of an acute angle are obtained and dropping is less likely to occur, whereby the connection reliability is further enhanced.

As shown in FIGS. **10**A to **10**C, a third embodiment is a case where the pointed portions **27**, **37** of saw-tooth shape are formed on the upper side of the fixed pieces **21**, **31** of the first and second connection terminals **20**, **30**. Others are similar to the first embodiment, and thus the description thereof will not be given.

According to the present embodiment, the alignment with the first and second movable contacts **29**, **39** is facilitated, and high dimensional accuracy is not required by forming the pointed portions **27**, **37** of saw-tooth shape. Thus, the manufacturing of the first and second connection terminals **20**, **30** is facilitated, and the productivity is enhanced.

In regards to the first connection terminal **20**, with the cross-sectional area of the coupling portion **22** as the aspect ratio 2 (first example) and the aspect ratio 1 (first comparative example), the operability in a case where the operation receiving portion **28** was operated with the operation lever **40** is simulated. The calculation result is shown in FIGS. **12**A and **12**B.

As shown in FIG. **12**A, if the push-up amount at the operation receiving portion is the same, larger contact force is obtained in the first example than in the first comparative example.

As shown in FIG. **12**B, if the push-up amount at the operation receiving portion is the same, the operation can be performed with a smaller operation force in the first example than in the first comparative example.

In other words, operation can be lightly performed and the connection state can be maintained with a strong force.

In regards to the second connection terminal **30**, with the cross-sectional area of the coupling portion **32** as the aspect ratio 2 (second example) and the aspect ratio 1 (second comparative example), the operability in a case where the operation receiving portion **38** was operated with the operation lever **40** was simulated. The calculation result is shown in FIG. **13**.

As shown in FIG. **13**, if the push-up amount at the operation receiving portion **38** is the same, greater displacement amount is obtained in the second example than in the second comparative example.

The coupling portions **22**, **32** of the first and second connection terminals **20**, **30** may not necessarily be straight and may be curved.

The connector connection terminal according to the present invention is not limited to the above described embodiments, and may have a shape that can be incorporated to another connector.

The coupling portion of the connector connection terminal according to the present invention is not limited to one having a uniform width dimension, and may have a shape that has a thick base and that becomes thinner towards the upper side.

While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

What is claimed is:

1. A connector connection terminal comprising:

a fixed piece to be inserted to a base of a connector, a coupling portion extending from the fixed piece, and a movable piece extending in parallel to the fixed piece to both sides from a free end of the coupling portion and being operated by an operation lever rotatably assembled to the base, wherein at least one of the fixed piece and the movable piece includes at least one pointed portion;

and wherein the connector connection terminal is formed through electroforming.

2. The connector connection terminal according to claim **1**, wherein a cutout is formed on the fixed piece.

3. The connector connection terminal according to claim **2**, wherein an edge on one side of the cutout is the pointed portion.

4. The connector connection terminal according to claim **2**, wherein an aspect ratio of a cross-sectional area of a bottom of the cutout is greater than or equal to 1.2.

5. The connector connection terminal according to claim **3**, wherein an aspect ratio of a cross-sectional area of a bottom of the cutout is greater than or equal to 1.2.

6. The connector connection terminal according to claim **1**, wherein a plurality of pointed portions is arranged side by side to form a saw-tooth shape.

7. The connector connection terminal according to claim **2**, wherein a plurality of pointed portions is arranged side by side to form a saw-tooth shape.

8. The connector connection terminal according to claim **3**, wherein a plurality of pointed portions is arranged side by side to form a saw-tooth shape.

9. The connector connection terminal according to claim 4, wherein a plurality of pointed portions is arranged side by side to form a saw-tooth shape.

10. The connector connection terminal according to claim 5, wherein a plurality of pointed portions is arranged side by side to form a saw-tooth shape.

11. The connector connection terminal according to claim 1, wherein a thickness of the pointed portion is thinner than a main body of the connector connection terminal.

12. The connector connection terminal according to claim 6, wherein a step is formed on one surface of the pointed end portion for thinning.

13. The connector connection terminal according to claim 6, wherein a step is formed on both surfaces of the pointed portion for thinning.

14. The connector connection terminal according to claim 6, wherein a thickness of the pointed portion is thinned by gradually reducing the thickness of the main body of the connector connection terminal.

15. A connector comprising a base and the connector connection terminal according to claim 1 in the base, wherein the connector connection terminal is configured to be operated by an operation lever.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,896,675 B2
APPLICATION NO. : 12/572166
DATED : March 1, 2011
INVENTOR(S) : Yoshinobu Hemmi et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims, claim 12, column 9, line 11, the word "**end**" should be omitted.

Signed and Sealed this
Thirty-first Day of May, 2011

David J. Kappos
Director of the United States Patent and Trademark Office